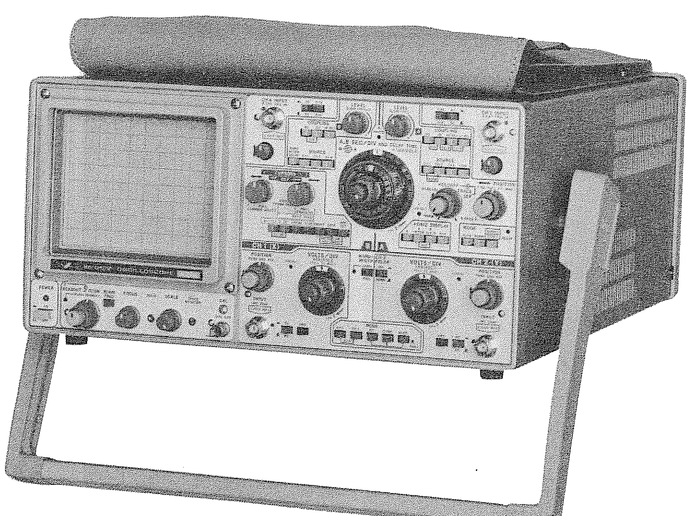
OPERATING MANUAL

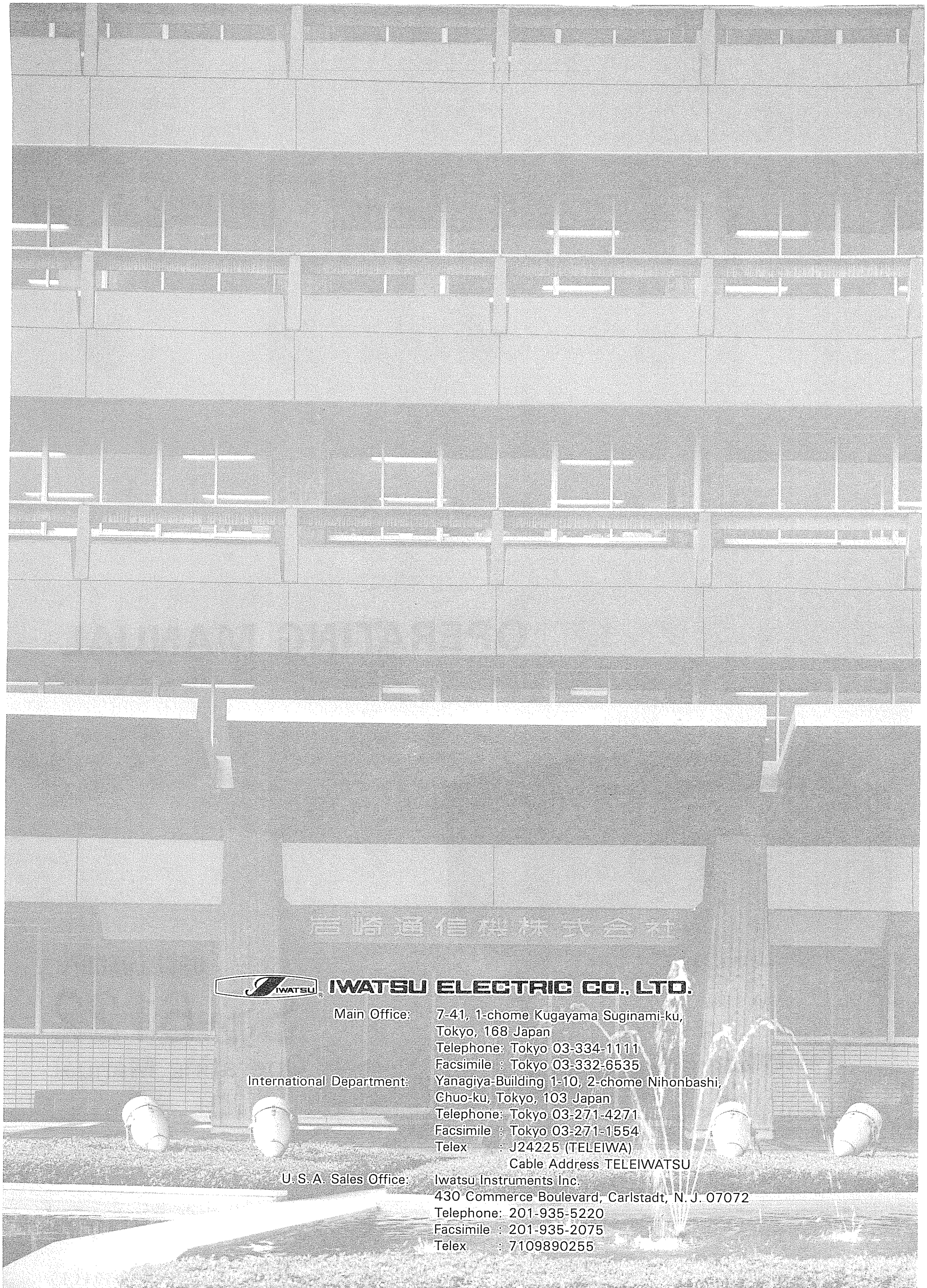


OSCILLOSCOPE

SS-6122

Operating Manual

B1955-011301(I)



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BEGINNING

Oscilloscope SS-6122 is an electronic measuring instrument that can provide a 4-phenomenon, 8-bright-line display with a frequency band width ranging from DC to 100 MHz.

This instruction manual describes the operating procedures in sections 1 to 4.

If you need to use this instrument immediately after purchasing, first read "paragraph 3-2 Basic Operations for Signal Observation (page 3-1) in Section 3." Operating Instructions.

Each section of this manual covers the following contents:

Section 1 describes electrical and mechanical specifications of SS-6122.

Section 2 describes the purpose and use of controls, switches, and connectors on the panel of SS-6122.

Section 3 describes the probe connecting method and various functions are described item by item.

Section 4 describes the method for measuring electrical signals using SS-6122.

Before using SS-6122, read this manual carefully to achieve an efficient use of it through correct handling.

Operators Safety Summary

Observe the following precautions in operating the SS-6122.

Line voltage check

Before plugging the power cord to an electrical output, be sure to check its voltage. The SS-6122 can be used on the line voltage shown in Table 1, which can be selected with the voltage selector plug on the rear panel. Also check the fuse in the rear panel as shown in Table 1. Operating the SS-6122 on other than the specified voltage can result in breakdown.

Before changing the voltage selector plug, or replacing the fuse, be sure to unplug the power cord from the electrical outlet.

Table 1

Set Position	Center Voltage	Voltage Range	Fuse
A	100V	90 to 110V	2A slow-blow
B	115V	103 to 128V	
C	220V	195 to 242V	1A slow-blow
D	230V/240V	207 to 264V	

Use the supplied power cord

Use the supplied 3-core power cord.

When operating the SS-6122 on the line voltage from a 2-core electrical outlet with the supplied 3-core power cord and a conversion adaptor, be sure to ground the ground terminal on the rear panel to prevent danger.

Be sure to replace the fuses with the correct ones

The SS-6122 uses the fuses shown in Table 2 to protect the circuits from damage by overcurrent.

If any of these fuses is burnt out, carefully determine the cause, repair a defect if any, and replace it with the correct one. Never use fuses other then specified because it can cause not only troubles but danger.

Table 2

Circuit No.	Fuse	Function	Position
21F 1	2A slow-blow	Voltages selector Plug A or B	Rear panel
	1A slow-blow	Voltages selector Plug C or D	
20F 10	1A slow-blow	CRT circuit protection	See Figure 1

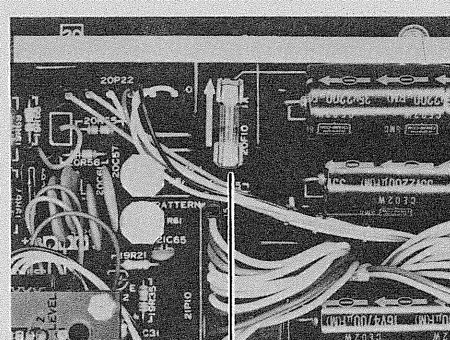
Do not apply excessive voltage

The input voltage limit of each input connector is as follows:

CH 1-2-3-4 INPUT	±250V MAX.
Probe input (Duty ratio 10:1)	600V (DC + peak AC)
Z AXIS INPUT	±50V MAX.

Do not apply voltage greater than this.

Figure 1. Fuse locations



20F 10 1A

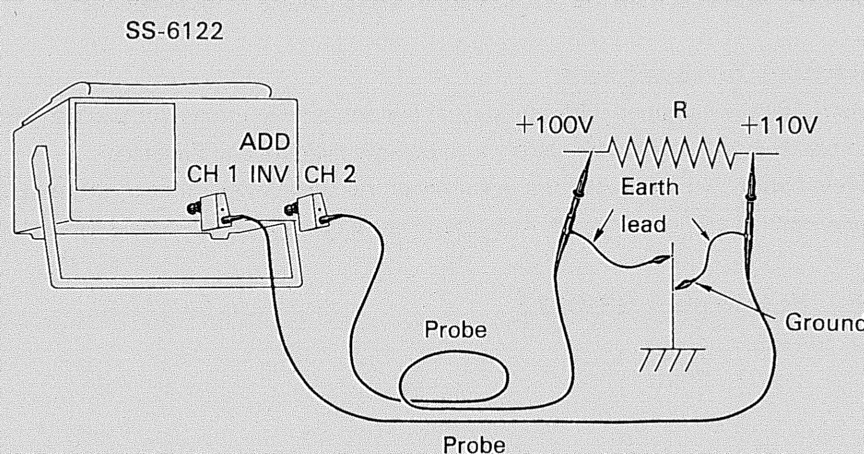
Grounding of ground sides of probe and input connector

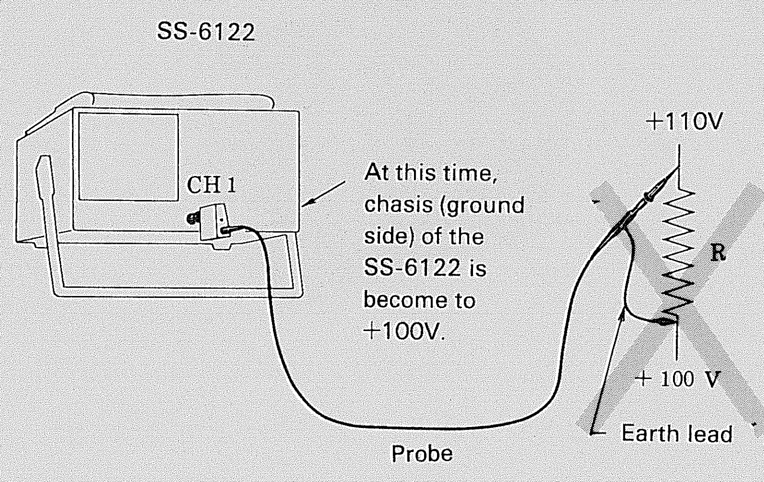
Be sure to connect the ground sides of the probe and signal input connector to the ground of the object to be measured to avoid electricity accidents.

During measurement of the floating potential with the oscilloscope, its chassis or the ground terminal of the probe may have potential. In this case, an electric shock may occur or the device may be brocken due to a large current flowing through the chassis. In such a case, pay attention to the state of potential or insulation between the devices connected.

It is recommended that the floating potential is measured by the differential method. (Figure 2 shows examples of connection)

Figure 2. Example of measured by the differential method





Ambient temperature and ventilation

The SS-6122 operate normally in the ambient temperature range of −10°C to +50°C. Be sure to use the SS-6122 with this range. Use of it outrange can result in some trouble. Do not place anything near the ventilating hole in the cover to block heat dissipation.

Do not increase light intensity excessively

Do not increase the light intensity of traces or spot more than necessary. Excessive light intensity can not only result in eyes fatigure but, if left for a long time, burn the CRT phosphor surface.

Using the SS-6122 with the CRT screen up

The SS-6122 can be used with the CRT screen up as shown in Figure 3. Be careful not to bring the SS-6122 down by pulling hard the probes connected to the signal input connector.

Internal battery for saving data

This instrument is equipped with an internal battery to save the cursor position, delay time, and comment when the power is truned off. The battery also powers the date and time clock.

When this battery becomes low, the accuracy of the save data cannot be assured. (However, this does not affect the normal operation of the oscilloscope.) Please contact your dealer when the battery becomes low.

Figure 3. How to place SS-6122

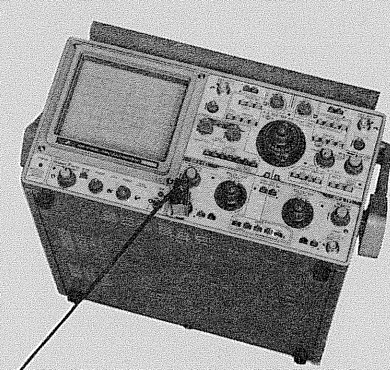


TABLE OF CONTENTS

Section 1

Specifications

1-1 GENERAL

The SS-6122 is an oscilloscope with a frequency bandwidth of DC to 100 MHz that can display 8 traces on 4 channels.

It has a variety of functions such as display readout, calculation by cursor, frequency/period measurement, comment input, and time/date display using an internal clock. Its high precision and performance makes it suitable not only for electronic device production line, maintenance and service, but also for electronic device research and development.

The SS-6122 is useful in a wide range of applications for not only production lines and maintenance and service purposes but also for the research and development of a variety of electronic devices. The features of the SS-6122 are as follows:

- In addiiton to display of 8 traces on 4 channels, the SS-6122 has an ADD function for measuring the sum of two signals and CH 2 POLAR for measurement of the difference between two signals.
- Both CH 1 and CH 2 have a high deflection factor of 1mV/div, which permits accurate measurement of voltages.
- The horizontal deflection system has sweep rates up to 2 nsec/div (in the x10 MAG function) so that even highspeed phenomena can be measured with accuracy.
- It has function of Delay sweep, Single sweep and ALT sweep. The TV synchronization signal enables composite video signal wave forms of TV etc. to be observed.
- Selection of trigger signal coupling and trigger signal source can be performed independently for sweep A and sweep B.
- The measurement conditions, measurement modes, and measurement results are displayed digitally on the CRT.
- Two cursors can be used to perform various measurements and calculations and the results are displayed on the CRT.
- Four V and H cursors can be used simultaneously to measure pulse rise and fall time.
- An internal reciprocal counter is used to display frequencies and periods up to six digits.
- An internal voltage meter enables DC voltage measurement and sine wave peak value detection. In addition, the peak value (sine wave) from the ground can be measured using the cursor.
- An internal clock enables displaying of time and date together with the measurement results.
- A comment input function enables displaying of variety of characters and symbols so that measurement notes and descriptions can be displayed on the screen.
- Infromation such as cursor position, delay time, comment, time, and date are backed up with battery so that they are saved when the power is turned off.

1-2 ELECTRICAL SPECIFICATIONS

1-2-1 Cathode-Ray Tube (CRT)

Shape	Rectangular, 6 inches
Display Area	8 div × 10 div (1 div = 10mm), with internal illuminated graticule of parallax-free type
Phosphor	B31 (Standard)

Accelerating Voltage Approximately 20kV

1-2-2 Vertical Deflection System (Y Axis)

Modes
CH 1, CH 2, ALT, CHOP, ADD, QUAD (Quadruple)
CHOP switching rate: 500kHz ±40%

Channels 1 and 2

Deflection Factor
5 mV/div to 5 V/div, in 10 calibrated steps in a 1-2-5 sequence
Accuracy: 1 mV/div, 2 mV/div (with X5 MAG)
±4% (+10°C to +35°C)
±8% (−10°C to +50°C)
5 mV/div to 5 V/div
±2% (+10°C to +35°C)
±5% (−10°C to +50°C)
I mV/div to 12.5 V/div continuously variable with the VARIABLE control and the X5 MAG function

Frequency Response
DC to 100 MHz, −3 dB (5 mV/div to 2 V/div)
DC to 100 MHz, −3.5 dB (5 V/div)
DC to 50 MHz, −3 dB (1 mV/div, 2 mV/div)
Notes
- 10°C to 35°C
- Bandwidth: The highest usable frequency is 20 MHz.
- AC coupling: The lowest usable frequency is 4Hz.

Rise Time
3.5 nsec (calculated) at 10 mV/div, 10°C to 35°C
[Note] Rise time calculated from: bandwidth × rise time=0.35

Pulse Response
Overshoot: 3%
Sag (at 1 kHz): 1%
Other distortion: 3%
(10 mV/div, 10°C to 35°C)

Signal Delay
Delay cable supplied

Input Coupling	AC, DC, GND
Input RC	Direct: 1 MΩ ±1.5%//25pF ±2pF With probe: 10 MΩ ±2%//14pF ±2pF
Maximum Input Voltage	±250 V Max.
Drift	0.1 div/hour or 2 mV/hour, whichever is larger, 30 minutes after power is turned on (standard)
Polarity Inversion	CH 2 only
Common Mode Rejection Ratio	At 10 mV/div 50:1 (1 kHz sine wave) 15:1 (20 MHz sine wave)

Channels 3 and 4

Deflection Factor	0.1 V/div, 0.5 V/div, selectable Accuracy: ±4% (at +10°C to +35°C) ±8% (at −10°C to +50°C)
Frequency Response	DC to 100 MHz −3 dB (0.1 V/div) DC to 100 MHz −3.5 dB (0.5 V/div) Notes • 10°C to 35°C • Bandwidth: The highest usable frequency is 20 MHz. AC coupling: The lowest usable frequency is 4 Hz.
Pulse Response	**Table 1-2-2** (+10°C to +35°C)

Waveform Distortion	0.1V/div	0.5V/div
Overshoot	7%	10%
Sag (at 1 kHz)	2%	2%
Other distortion	5%	5%

Input Coupling	AC, DC
Input RC	Direct: 1MΩ±1.5%//27pF±3pF With probe: 10MΩ±2%//14pF±2pF
Maximum Input Voltage	±250 V Max.

1-2-3 Triggering

A-Triggering

Signal Sources: CH 1, CH 2, CH 3, NORM, LINE
(External trigger can be used by selecting CH 3 with SOURCE switch)

Coupling: AC, DC, HF REJ, LF REJ, FIX, TV-H, TV-V

Slope: Positive-going (+),
negative-going (–)

Minimum Trigger Sensitivity: **Table 1-2-3-(1)** (+10°C to +35°C)

Frequency	Sensitivity of CH 1, CH 2, CH 3
DC to 10 MHz	0.3 div
10 MHz to 50 MHz	1 div
50 MHz to 100 MHz	1.5 div

Notes
- FIX: 1 div at 100 Hz to 10 MHz,
  : 2 div at 10 MHz to 50 MHz Sine waves only
- TV-V, TV-H synchronizing signal level: 1 div or more on screen amplitude for a composite video signal composed of 7 parts video signal and 3 parts synchronizing signal
- Trigger signals are attenuated in the following frequency ranges depending on coupling
  AC: 30 Hz or lower
  HF REJ: 10 kHz or higher
  LF REJ: 10 kHz or lower
- AUTO sweep mode: The lowest usable frequency is 50 Hz

Maximum Input Voltage: ±250 V MAX (CH 3 INPUT/A EXT TRIG IN)

Input RC: Same as CH 3

B-Triggering

Signal Sources: RUNS AFTER DELAY, CH 1, CH 2, CH 4
(External trigger can be used by selecting CH 4 with SOURCE switch.)

Coupling: AC, DC, HF REJ, FIX

Slope: Positive-going (+),
negative-going (–)

Minimum Trigger Sensitivity

Table 1-2-3-(2) (+10°C to +35°C)

Frequency	Sensitivity of CH 1, CH 2, CH 4
DC to 10 MHz	0.3 div
10 MHz to 50 MHz	1 div
50 MHz to 100 MHz	1.5 div

- FIX: 1 div at 100 Hz to 10 MHz,
  : 2 div at 10 MHz to 50 MHz. Sine waves only
- HF REJ: Trigger signal is attenuated at 10 kHz or higher.
- However, LF REJ and TV-V are excluded. (Set A trigger of TV-H to TV-V.)

Maximum Input Voltage ±250V MAX. (CH4 INPUT/B EXT TRIG IN)

Input RC Same as CH 4

1-2-4 Horizontal Deflection System (X Axis)

Horiz Display A, A INTEN, ALT, B DLY'D, X - Y

A-Sweep

Sweep Mode AUTO, NORM, SINGLE

Sweep Rates 20 nsec/div to 0.5 sec/div in 23 calibrated steps in a 1-2-5 sequence

20 nsec/div to 1.25 sec/div, continuously variable with the VARIABLE control

Accuracy I (Over center 8 divisions):

±2% (+10°C to +35°C)

±4% (−10°C to +50°C)

Accuracy II (Over 2 of the center 8 divisions):

±5% (−10°C to +50°C)

Hold-Off Time Variable with the HOLD OFF control

B-Sweep

Delay Continuous delay (RUNS AFTER DELAY), triggered delay (CH 1, CH 2, CH 4)

Sweep Rates 20 nsec/div to 50 msec/div, 20 calibrated steps in a 1-2-5 sequence

Accuracy I (Over center 8 divisions):

±2% (+10°C to +35°C)

±4% (−10°C to +50°C)

Accuracy II (Over any 2 of the center 8 divisions):

±5% (−10°C to +50°C)

Time Difference Measurement Display error: ±0.5% of reading ±1.0% of full scale

Delay Jitter 1/20,000 or less

Sweep Magnification

10 times
(Maximum sweep rate: 2 nsec/div)
Accuracy I of magnified sweep rate (Over center 8 divisions):

20 ns/div to 50 ns/div	±5% (+10°C to +35°C)
0.1 μs/div to 0.5 μs/div	±3% (+10°C to +35°C)
20 ns/div to 50 ns/div	±7% (−10°C to +50°C)
+ 0.1 ms/div to 0.5 s/div	±6% (−10°C to +50°C)

Accuracy II of magnified sweep rate (Over any 2 of the center 8 divisions):

20 ns/div to 50 ns/div	±10% (+10°C to +35°C)
0.1 μs/div to 0.5 μs/div	±6% (+10°C to +35°C)
1 μs/div to 0.5 s/div	±5% (+10°C to +35°C)

Excluding 30ns from sweep start and 40ns before sweep end.

1-2-5 X — Y Operation

Input X Axis: CH 1, Y Axis: CH 2

X Axis (Same as CH 1 except for the following)

Deflection Factor	Same as CH 1
	Accuracy: 5 mV/div to 5 V div ±3% (+10°C to +35°C)
	±5% (−10°C to +50°C)
Frequency Response	DC to 2MHz, −3 dB (10°C to 35°C)
Input RC	Same as CH 1
Maximum Input Voltage	Same as CH 1

Y Axis

Deflection Factor	Same as CH 2
Frequency Response	Same as CH 2
Input RC	Same as CH 2
Maximum Input Voltage	Same as CH 2

X - Y Phase Defference 3° or less (at DC to 100 kHz)

1-2-6 External Intensity Modulation (Z Axis)

Input Voltage	0.5 Vp-p
Polarity	Positive (decleases intensity), negative (inclease intensity)
Frequency Range	DC to 5 MHz
Input Resistance	4.6 kΩ ±10%
Maximum Input Voltage	±50 V Max.

1-2-7 Signal Outputs

Calibrator

Waveform	Square wave
Repetition Frequency	1 kHz Accuracy: ±1% (at +10°C to +35°C) ±2% (at −10°C to +50°C)
Duty Ratio	40% to 60%
Output Voltage	0.6 V Accuracy: ±1% (at +10°C to +35°C) ±1.5% (at −10°C to +50°C)
Output Current	10 mA Accuracy: ±1% (at +10°C to +35°C) ±2% (at −10°C to +50°C)

CH 1 OUT

Output Voltage	40 mV ±20% per div of amplitude on the CRT screen (at 50Ω terminated)
Frequency Response	DC to 50 MHz, −3 dB
Output Resistance	50Ω ±20%

A Gate Out

Output Voltage	Approximately +5 V (Base line: Approximately 0V)
Output Resistance	Approximately 2.7 kΩ

B Gate Out

Same as A gate Out

1-2-8 Readout and Cursor Measurement

Readout

Measurement Condition	Set by switches on the panel
Cursor	Two parallel vertical and horizontal cursors
Delay Time	Delay sweep start time
Counter	Six digit frequency or period
Peak Detector	DC voltage, sine wave peak value, sine wave effective value
Date and Time	day-month-year hour:minute
Comment Input	Maximum of 80 characters

Cursor Measurement

Voltage Difference (Δt)	Displays the voltage difference between the cursors Accuracy: ±0.5% of reading ±1.6% of full scale (6 div)
Voltage Ratio (%, dB)	5 div = 100%, 0.0 dB or any division = 100%, 0.0 dB Accuracy: ±0.5% of reading ±1.6% of full scale (6 div)

Time Difference (Δt)	Displays the time difference between the displayed cursors Accuracy: ±0.5% of reading ±1.3% of full scale (8 div)
Frequency (1/Δt)	Value measured by Δt displayed as 1/Δt (frequency) Accuracy: ±0.5% of reading ±1.3% of full scale (8 div)
Phase Difference	5 div = 360° or any division = 360° Accuracy: ±0.5% of reading ±1.3% of full scale (8 div)
Period Ratio	Percentage of one input frequency period Accuracy: ±0.5% of reading ±1.3% of full scale (8 div)
Cursor Movement Range	Vert: ±3.6 div or more from center Horiz: ±4.5 div or more from center

Delay Time

Resolution	1/400 div
Delay Time Range	0.2 div to 10.2 div Display error: ±0.5% of reading ±1.0% of full scale (A sweep MAG x 10)

Peak Detector

DC Voltage	
Resolution	1/100 div or more
AC voltage	
Measurement Frequency Range	10Hz to 3MHz (sine wave)
Resolution	1/100 div or more

Date and Time

Display Format	IWATSU DD-MMM-YY ⊔TT:MM DD: date (two digits: 01 to 31) MMM: month (three characters: JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC) YY: year (two digits: 00 to 99) ⊔ : space TT: time (two digits: 00 to 23) MM: minute (two digits: 00 to 59)
Monthly Error	±1 minute

Comment Input

Display Range	Display lines 4 to 18
Displayed Characters	Maximum of 80 characters
Character Types	See table in section 1-2-8

Data Save

	Internal battery backup
Saved Data	Cursor position, delay time, comment, date and time
Battery Life	Approximately 40,000 hours (at room temperature)

Table 1-2-8 Comment characters

	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
P	Q	R	S	T	U	V	W	X	Y	Z	[	¥	]	^	_
`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
p	q	r	s	t	u	v	w	x	y	z	{	|	}	¯	±
×	÷	≦	≧	≠	∞	~	‖	[	]		→	←	↑	↓	△
Ω	μ	π	/												

1-2-9 Counter

Input Voltage

Table 1-2-9

Frequency	Display deflection width	
	CH1, CH2	CH3
10 Hz to 2MHz	1 div	1 div
2 Mz to 20MHz	2 div	2 div
20 Mz to 100MHz	3 div	3 div

The values at above are minimum deflections for which triggering is possible. The maximum deflection is 8 div within effective display area.

Count Time: 0.1s

Frequency Measurement Range: 10Hz to 100MHz

Period Measurement Range: 0.1s to 10ns

Measurement Resolution: 6 digits (frequency and period measurement)

Measurement Error: Reference oscillator accuracy ±1 count (at 10MHz or higher or 0.1μs or faster)

$$\text{Reference oscillator accuracy} + \frac{\text{Trigger error} \pm 1 \text{ reference time}}{\text{Measuring period} \times 0.1 \text{ s}}$$

(at 10MHz or lower or 0.1μs or slower)

Reference Oscillator

Frequency: 10MHz

Aging Rate: ±3ppm/year

Temperature Characteristic ±10ppm/0 to 50°C

1-2-10 Power Supply

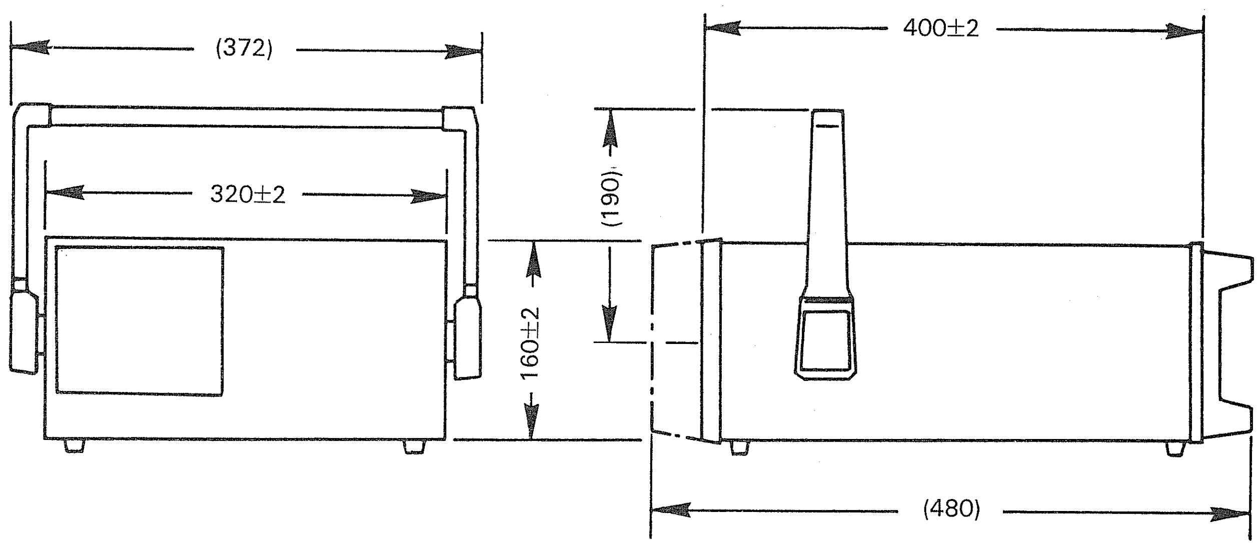
Voltage Range	110 V (90 to 110 V)/ 115 V (103 to 128 V)/ 220 V (195 to 242 V)/ 230 V, 240 V (207 to 264 V) AC One of these voltage ranges can be selected with voltage selector plug.
Frequency Range	50 to 440 Hz
Power Consumption	Approximately 70 W (at 100 V AC)

1-3 MECHANICAL SPECIFICATIONS

1-3-1 Weight and Dimensions

Weight	Approximately 11.8 kg (Without panel cover, accessories and accessories bag)
Dimensions	320 ± 2(W) × 160 ± 2(H) × 400 ± 2(L)(mm) See Figure 1-3-1.

Figure 1-3-1 Dimensions



1-4 ENVIRONMENTAL CHARACTERISTICS

Operating Temperature	–10°C to +50°C
Operating Humidity	40°C, 90% Relative Humidity
Storage Temperature	–20°C to +70°C
Storage Humidity	70°C, 80% Relative Humidity
Altitude	Operating: 5,000 m maximum (atmospheric pressure 405 mmHg) Non-operating: 15,000 m maximum (atmospheric pressure 90.4 mmHg)
Vibration	From 10 Hz to 55 Hz and back in 1 minute; double amplitude 0.63 mm; for 15 minutes each in vertical, horizontal, and longitudinal directions for a total of 45 minutes.
Impact	One side is raised to an elevation angle of 45° (10 cm maximum), and let fall on a piece of hard wood banch. Each side is put to this test 3 times.
Drop	A package ready for transportation is dropped from a height of 90 cm.

1-5 ACCESSORIES

Power cord 1
Probe 2
Fuse 2
Panel Cover 1
Dust Cover 1
Instruction Manual 1
Accessories Bag 1

Section 2

Operating Information

2-1 NOTE

Definition of Pushbutton Switches

In this manual, the setting state of various pushbuttton switches used in this ocilloscope is defined as follows:

- In the case of interlocking type pushbutton switches and push-push switches, the state of each switch whose button was pushed is called IN (⊓); the state of the switch whose button was projected back by pushing again is called OUT (⎍). Generally, any interlocking type pushbutton switch has an IN (⊓) mark printed on the panel and any push-push switch has an In and OUT (⊓ · ⎍) mark.
- The operating state of some non-interlocking type push-button switches is indicated by lighting or going-out of their indicator lamps.

Control and Switch Function Notations

The functions of controls and switchs on this instrument are noted as follows:

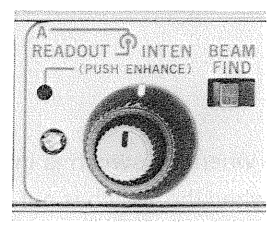
- When the function is described above the control switch

<Example 1>

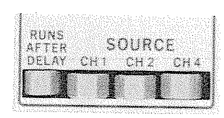
The outer control and inner control both have the INTEN function, but the outer control is the INTEN control for the displayed waveform and the inner control is the INTEN control for the displayed characters.

Also, when the inner control is pressed, it performs the ENHANCE function and turns on the LED on the left.

<Example 1>

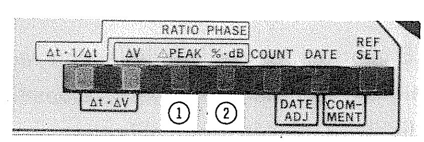


<Example 2>



The function described above the switch is enabled when the switch is pressed.

<Example 3>



① Switch

When the Δt·1/Δt switch is pressed:
RATIO function is enabled.

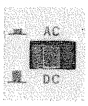
When the ΔV switch is pressed:
PEAK function is enabled.

② **Switch**

When the Δt·1/Δt switch is pressed:
PHASE function is enabled.
When the ΔV switch is pressed:
%·dB function is enabled.

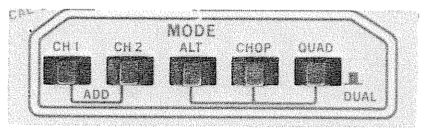
- When the functions are described above and below the switch.

<Example 4>

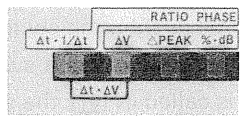


The AC function is enabled when the switch is in and the DC function is enabled when the switch is out.

<Example 5>



CH1 function is enabled when CH1 switch is pressed.
CH2 function is enabled when CH2 switch is pressed.
ADD function is enabled when CH1 and CH2 are pressed together.



Δt·1/Δt function is enabled when Δt·1/Δt switch is pressed.
ΔV function is enabled when ΔV switch is pressed.
Δt·ΔV function is enabled when Δt·1/Δt switch and ΔV switch are pressed together.

2-2 CONTROLS AND SWITCHES

The functions of the switches and controls on the front and rear panels are explained. Refer to Figure 2-2-1 and 2-2-2.

If the VARIABLE controls for vertical deflection factor and sweep rate are set to other than the CAL position, the LED indicator lights to indicate non-calibration.

Figure 2-2-1. Front panel

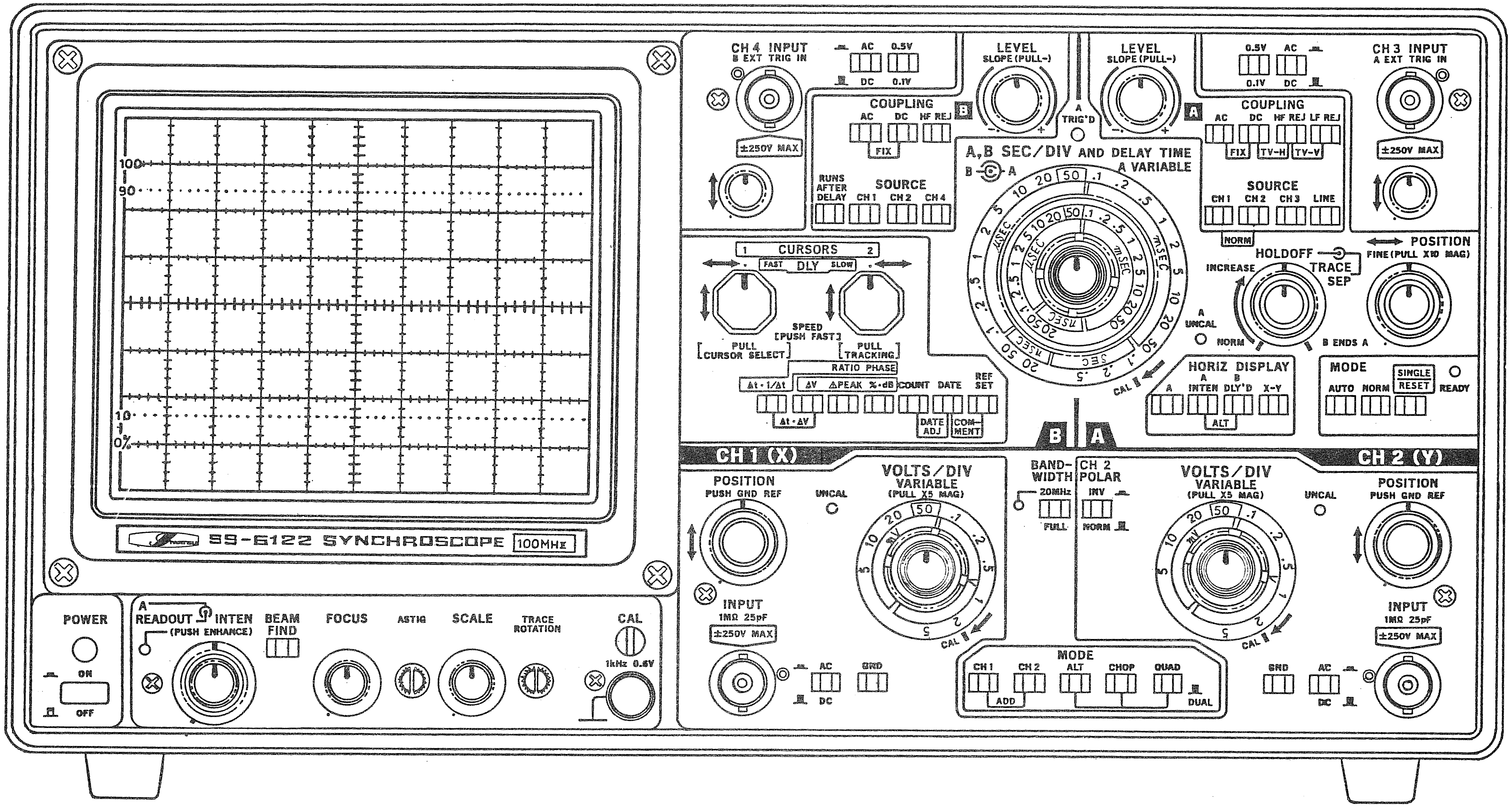
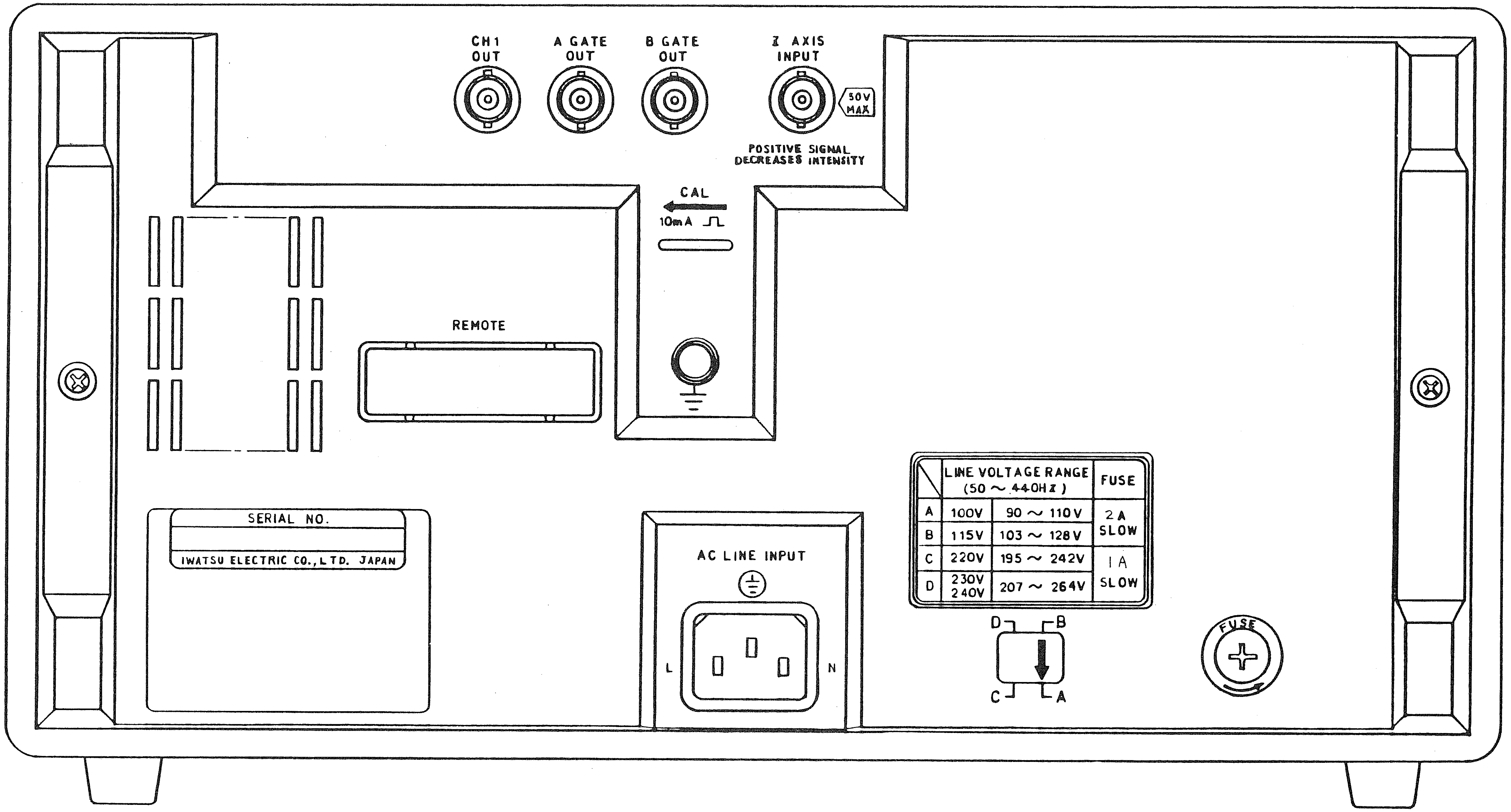


Figure 2-2-2. Rear panel



2-3 FRONT PANEL

2-3-1 Power supply, CRT, CALIBRATOR

Power, CRT and Calibration controls

① POWER ON/OFF

Power switch

② POWER ON

Turns on when the power is on.

③ A INTEN

A INTEN (outer control): Adjuster for increasing or decreasing the intensity of the waveforms. When turning clockwise, the intensity increase; when turning counter-clockwise, the intensity decreases.

④ READOUT·(PUSH ENHANCE) (inner control)

READOUT: Adjust the readout readout display brightness. The display brightens when turned clockwise and darkens when turned counterclockwise.

(PUSH ENHANCE): Turns on ENHANCE and increases the brightness of the trace line and point when depressed (when A sweep time is between 2ms/div and 20ns/div).

⑤ PUSH ENHANCE

Turns on when PUSH ENHANCE is on.

⑥ BEAM FIND

Search the trace or spot positions. If the button is pushed when a trace or spot is outside the screen, it appears on the CRT screen.

⑦ FOCUS

Focus traces or spot.

⑧ ASTIG

Use this control when traces or spots cannot be focus with the FOCUS control.

⑨ SCALE

Adjust the brightness scale. Turning it clockwise brightens the scale, and turning it counterclockwise darkens the scale.

⑩ TRACE ROTATION

Adjust traces parallel to the horizontal graticule lines.

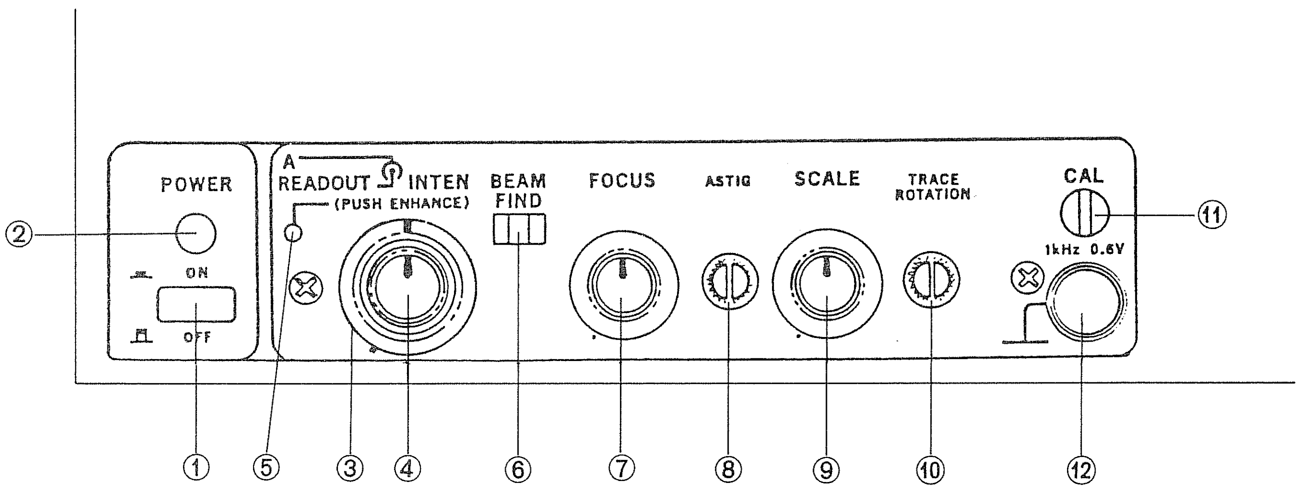
⑪ CAL lkHz 0.6 V

Signal output terminal of a square wave with a calibration voltage of 0.6 V and a repetition frequency of 1 kHz. The output signal is used for adjusting vertical axis deflection factor, probe phase, and sweep rate.

⑫ ⊥ (Ground terminal for measurement)

Signal ground treminal for measurement. Connect it to the ground terminal of the circuit to be measured.

Figure 2-3-1. Power, CRT and Calibration controls



2-3-2 Vertical Deflection System

⑬ VOLTS/DIV (CH 1, CH 2) (Outer control)

Set the vertical deflection factor to select one of 10 positions from 5 mV/div to 5 V//div to suit input signal level.

5 mV/div and 10 mV/div change to 1mV/div and 2mV/div when x5 MAG is set.

The VOLTS/DIV switches represent the voltage (of an input signal) per division of the scale on the CRT screen where the VARIABLE control is set to the CAL position.

⑭ VARIABLE (PULL x5 MAG) (CH 1, CH 2) (inner control)

The VARIABLE control has the deflection factor adjusting function.

The VARIABLE controls are used to continuously variable the vertical deflection factor. The deflection factor is 2.5 times or more when the control is turned fully counterclockwise.

(PULL x5 MAG): When the x5 MAG control is pulled, the volts/div value is multiplied by 5.

⑮ UNCAL (CH 1, CH 2)

If the VARIABLE control is set to other than the CAL position, this lamp lights to indicate non-calibration.

⑯ ↕ POSITION·PUSH GND REF (CH 1, CH 2)

Adjusts the vertical location of a trace or spot. Turning the control clockwise moves a trace or spot upward, and turning the control counterclockwise moves it downward.

PUSH GND REF: When the PUSH GND REF control is pressed, the vertical amplifier input is grounded and the ground voltage is displayed on the screen.

⑰ AC-DC, GND (CH 1, CH 2, CH 3, CH 4)

Switch for selecting a signal input coupling.

AC: The vertical deflection input is AC-coupled. Even if AC input signal is superimposed on DC signal, the DC component is blocked so only the AC component is allowed to pass.

DC: The vertical deflection input is DC-coupled. All the frequency components, including DC, are allowed to pass through.

GND: By pushing the switch, it is set to the GND positon. This operation allows GND setting for CH 1 in the MODE of the vertical, or for CH 2 MODE, or for CH 1 and CH 2 in the ALT and CHOP modes.

⑱ INPUT (CH 1-X, CH 2-Y)

Connector for connecting a probe or cable to apply input signal to be measured.

The maximum input voltage is ±250 V maximum where input signals are directly applied; or 600 V (DC + peak AC) where a probe is used.

(For the maximum input voltage where a probe is used, refer to the instruction manual for probe.)

⑲ MODE

These MODE button are used for switching vertical deflection operation. The following modes can be selected.

CH 1: Only signal which is applied to CH 1 INPUT is displayed on the CRT screen.

CH 2: Only signal which is applied to CH 2 INPUT is displayed on the CRT screen.

ALT: The two signals applied to CH 1 and CH 2 INPUT connectors are displayed on the CRT screen. This mode is suitable for observing waveforms where SEC/DIV is set to a position faster than I msec/div.

CHOP: The two signals applied to CH 1 and CH 2 INPUT connectors are displayed on the CRT screen. This mode is suitable for observing waveforms where SEC/ DIV si set to a position slower than I msec/div.

ADD: The ADD mode is selected when both CH 1 CH 2 buttons are simultaneously pushed IN. This mode is used for observing the algebraic sum of the signals applied to CH 1 and CH 2 INPUT connectors or their difference. CH 1±CH 2 can be selected with CH 2 POLAR.

QUAD: If the QUAD button is IN when the ALT or CHOP button is IN position, quadruple traces are displayed on the CRT screen. This mode is used for simultaneously displaying the signals applied to CH 1, CH 2, CH 3, and CH 4 INPUT connectors on the CRT screen. Either of the two following quad modes can be selected.

> Quad-trace display in the ALT mode: if the ALT and QUAD buttons are pushed IN, ALT operation takes place to display 4 signals on the CRT screen.
>
> Quad-trace display in the CHOP mode: if the CHOP and QUAD button are pushed IN, CHOP operation takes place to display 4 signals on the CRT screen.

If the HORIZ DISPLAY ALT button is IN during the above operations, the 4 signals are displayed on the CRT screen. If the QUAD button is pushed again to the out (DUAL) position, the SS-6122 operates in the ALT or CHOP mode as indicated on the panel.

⑳ BAND WIDTH (20 MHz to 100 MHz)

Switch for selecting the frequency response of the vertical deflection system (CH 1, CH 2, CH 3, CH 4).

When pushing the switch once, the band width of all the channels is set to 20 MHz. (The indicator of LED lights.) Thus, the trace is clearly displayed width with the noise component cut, e.g.in:

- Since the deflection factor is kept higher at the time of small amplitude signal observation, the noise component increases and the observation may therefore be difficult. In such a case, the frequency band width is set to 20 MHz, if possible. When pushing the switch again, the band width of all the channels is set to 100 MHz. (The indicator of LED lights.)

With the switch pushed once more, all the indicator LEDs go out and the band width is set to the value described in Section 1-2-2.

㉑ CH 2 POLAR POLARITY INV-NORM

Select the polarity of signal applied to CH 2. NORM when the button is OUT; and INV when the button is IN where the polarity is inverted.

Figure 2-3-2-1. Vertical deflection (CH 1 and CH 2)

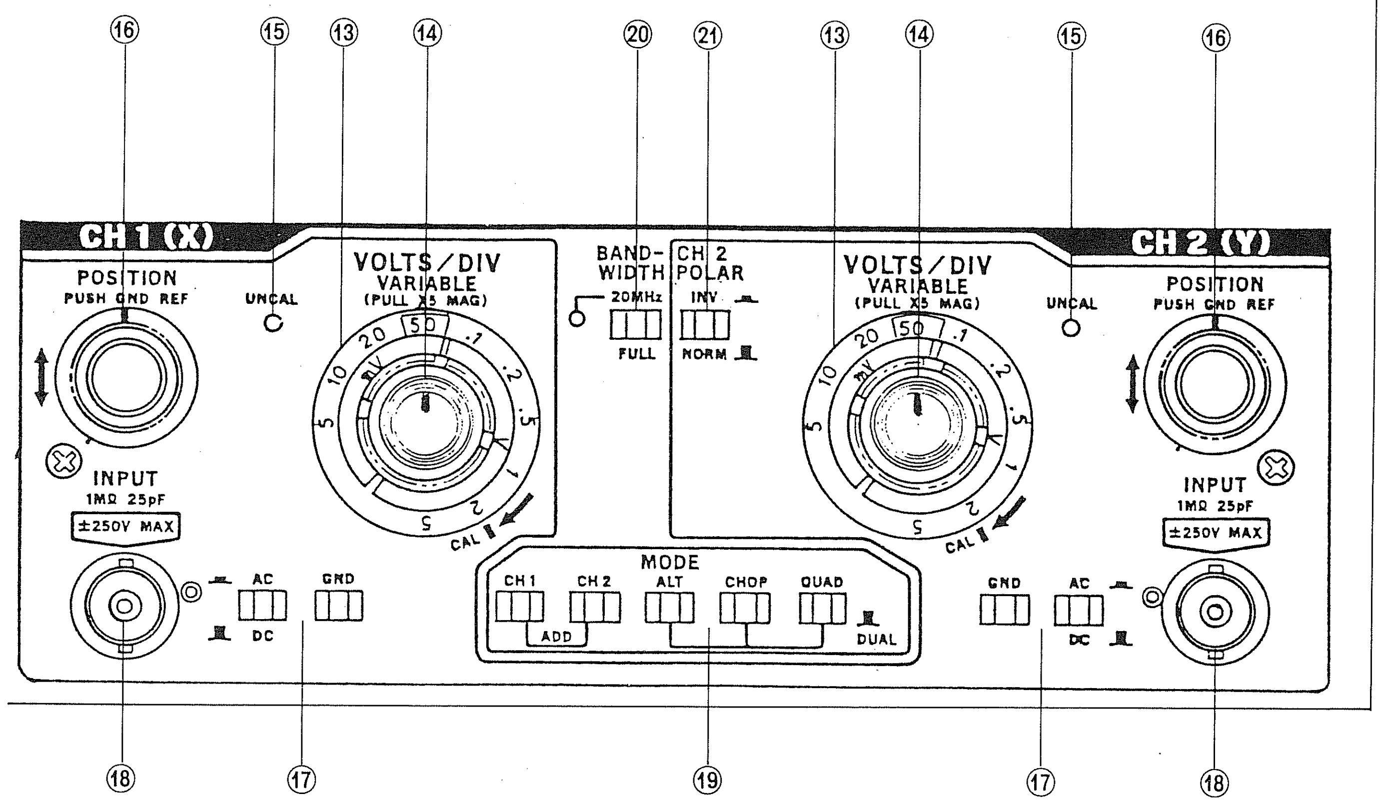
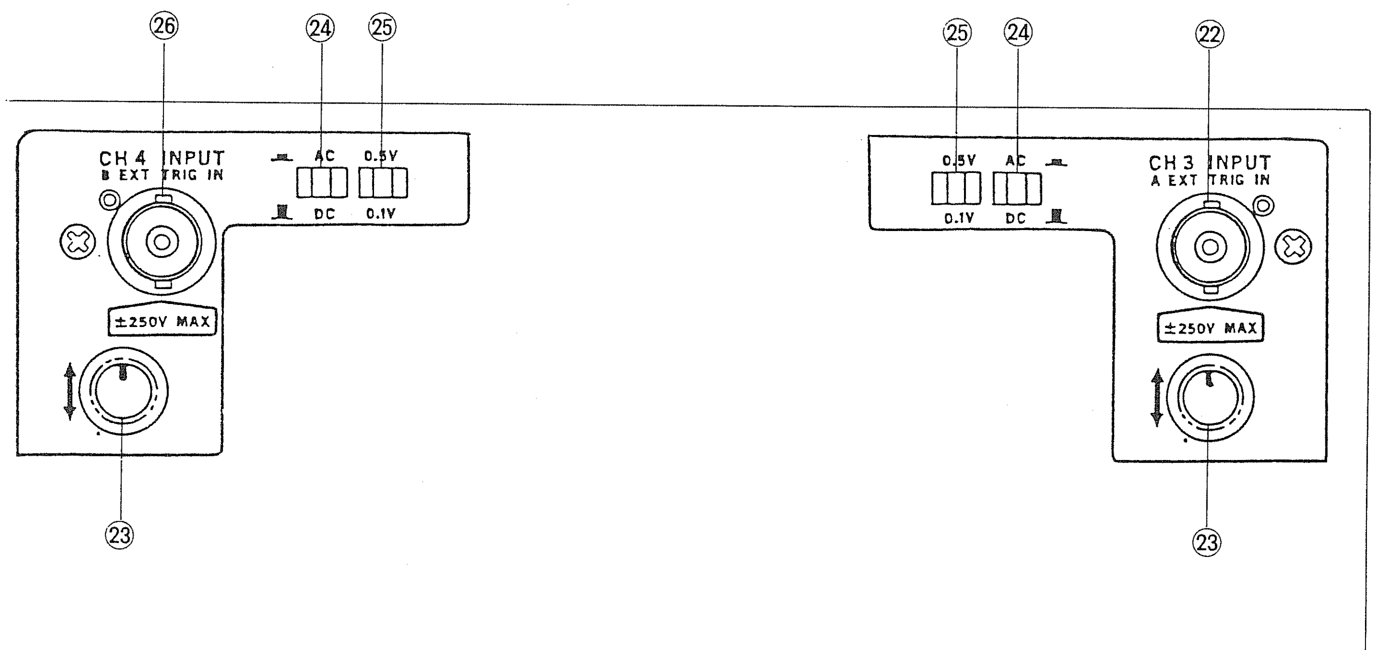


Figure 2-3-2-2. Vertical deflection (CH 3 and CH 4)



2-3-3 Triggering (A-sweep, B-sweep)

㉗ SOURCE

Select the SOURCE of trigger signal.

CH 1: The input signal applied to CH 1 INPUT is branched out as internal trigger signal.

CH 2: The input signal applied to CH 2 INPUT is branched out as internal trigger signal.

CH 3 (A SOURCE): The input signal applied to CH 3 INPUT is branced out as internal/ external trigger signal.

CH 4 (B SOURCE): The input signal applied to CH 4 INPUT is branched out as internal/ external trigger signal.

NORM: (A SOURCE): If both the CH 1 and CH 2 buttons are simultaneously pushed in, the NORM mode is selected, in which the signal for the waveform displayed on the CRT screen in connection with a vertical mode is used as a trigger signal. (For a detailed description of trigger signal selection, refer to the subsequent paragraph on triggering.)

LINE (A SOURCE): The SS-6122's power line signal is used as trigger signal. This mode is used for observing line signal and line harmonics.

RUNS AFTER DELAY (B SOURCE only): Delay method changes to continous delay.

㉘ COUPLING (A-Sweep, B-Sweep)

For selecting the trigger coupling (trigger circuit input coupling).

AC: AC coupling is selected. Trigger signal of the DC component is blocked. AC signal is only used for triggering.

DC: DC coupling is selected. DC can be used for triggering.

HF REJ: Frequencies over approximately 10 kHz are attenuated by a lowpass filter. Suitable for observing signals cleared of high-frequency noise.

LF REJ (A COUPLING): Highpass filter coupling to attenuate low frequencies under approximately 10 kHz.

Suitable for observing signals cleard a low-frequency noise.

TV-H (A COUPLING): If both the DC and HF REJ buttons are simultaneously pushed in, TV-H coupling is selected. This trigger coupling is used for observing a composite video signal waveform over a period of 1 H by triggering with a television horizontal synchronizing pulse.

TV-V (A COUPLING): If both the HF REJ and LF REJ buttons are simultaneously pushed in, TV-V coupling is selected. This trigger coupling is used for observing a composite video signal waveform over a period of 1 V by triggering with a television vertical synchronizing pulse.

FIX: If both the AC and DC buttons are simultaneously pushed in, this trigger level is fixed nearly at the zero level. Thus, it is not necessary to operate the LEVEL control.

㉙ LEVEL SLOPE (PULL-) (A-Trigger, B-Trigger)

This control has trigger level setting and trigger slope selecting functions

Push it for positive-going slope trigger level selection; ro pull it for negative-going slope trigger level selection.

㉚ A TRIG'D

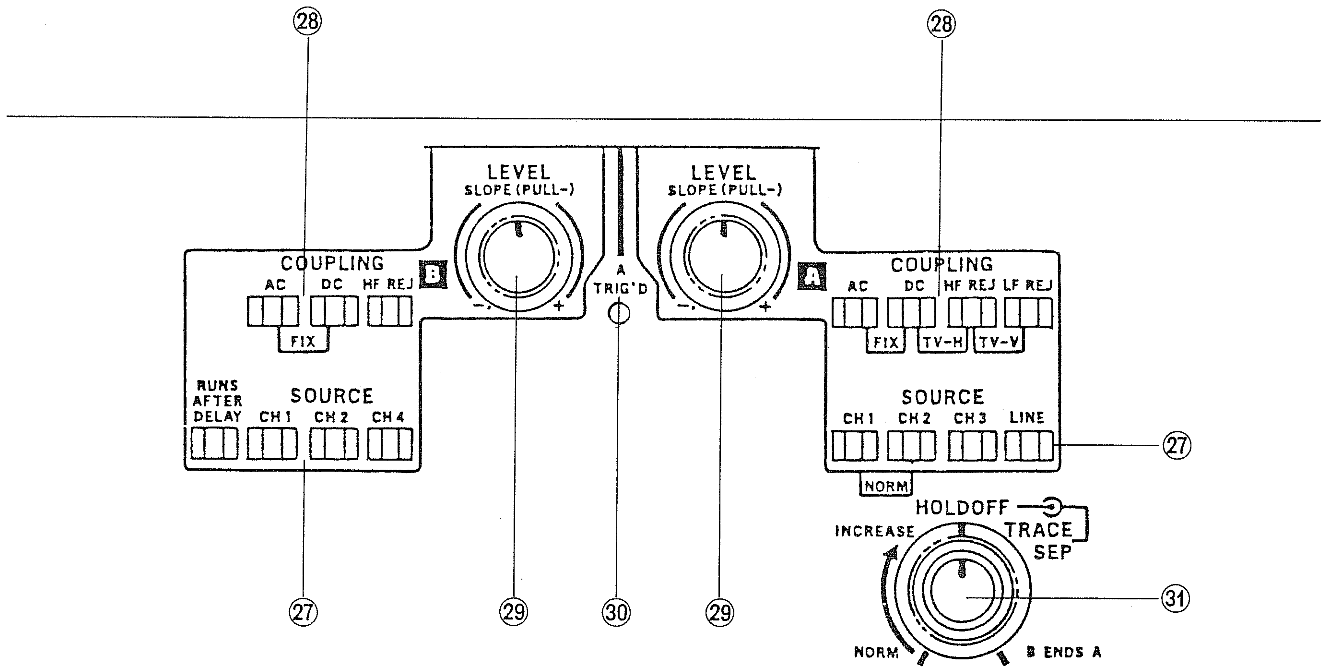
This lamp lights to indicate a triggering state.

㉛ HOLDOFF (innder control)

This control is used for stabilized synchronization of complex (composite) pulse waveforms. Turning the control fully counterclockwise to NORM minimizes the holdoff period, and turning at clockwise continuously increases the holdoff period.

When the control is turned fully clockwise to B ENDS A, A-sweep ends simultaneously with B-sweep, provided that the HORIZ DISPLAY button A INTEN, ALT or B (DLY'D) is pushed in. This prevents intensity decrease for delayed sweeps with a high magnification ratio.

Figure 2-3-3. Triggering



2-3-4. Horizontal Deflection System

㉜ MODE

This button selects either of the following trigger modes.

AUTO: In the AUTO mode, a sweep is started if trigger condition is readied; or a fre-running sweep takes place otherwise.

NORM: In the NORM mode, a sweep is started if trigger condition is readied; or no sweep take place otherwise.

SINGLE/RESET: The single trigger mode. This button also has a RESET funciton so, no trigger signal, it puts the SS-6122 into a ready condition, which is indicated by the lighting of the READY's LED on the right.

㉝ READY

This LED lights when the SS-6122 in a ready state in the single sweep mode.

㉞ HORIZ DISPLAY

The following modes can be selected with the horizontal deflection control buttons.

A: A sweep mode for normal waveform observation. Sweep time can be selected with the A SEC/DIV switch and A VARIABLE control.

A INTEN: The B-sweep is intensity-modulated and displayed on the A-sweep to check the start position of the B-sweep (delay sweep) and sweep length. A sweep rate can be selected with the A SEC/DIV and B-sweep width (sweep rate) with the B SEC/DIV.

ALT: Alternate A INTEN sweep and B sweep.

B: B sweep delay mode (in which the part selected by delayed sweep is magnified).

X - Y: Mode in which the SS-6122 is used as an X - Y scope, CH 1 serving as X axis and CH 2 as Y axis.

In this mode, the position of the waveform on the screen can be adjusted vertically with the ↕ POSITION for CH 2 and horizontally with the ↔ POSITION and FINE. In this case, the function of the FINE (PULL x10 MAG) does not operate.

㉟ A, B SEC/DIV and DELAY TIME

The outer control is for A SEC/DIV and DELAY TIME, and the inner control for B SEC/DIV.

The A SEC/DIV AND DELAY TIME control has 23 A-sweep positions from 20 nsec/div to 0.5 sec/div, and selects delays in A INTEN sweep or B (DLY'D) sweep. The value of each position of the control represents a sweep rate and delay time per division on the CRT screen where the A VARIABLE control is turned fully clockwise to the CAI position.

The B SEC/DIV control has 20-sweep positions from 20 nsec/div to 50 msec/div, but no VARIABLE control.

㊱ A VARIABLE

Provides continuously the varies A-sweep rate. If the control is turned fully counterclockwise, the value of where the SEC/DIV switch is set at least 2.5 times or more.

㊲ A UNCAL

This lamp lights to indicate that A sweep rate is uncalibrating state when A VARIABLE control is out of CAL position.

㊳ ↔ POSITION (outer control)

Moves the trace or spot horizontally.

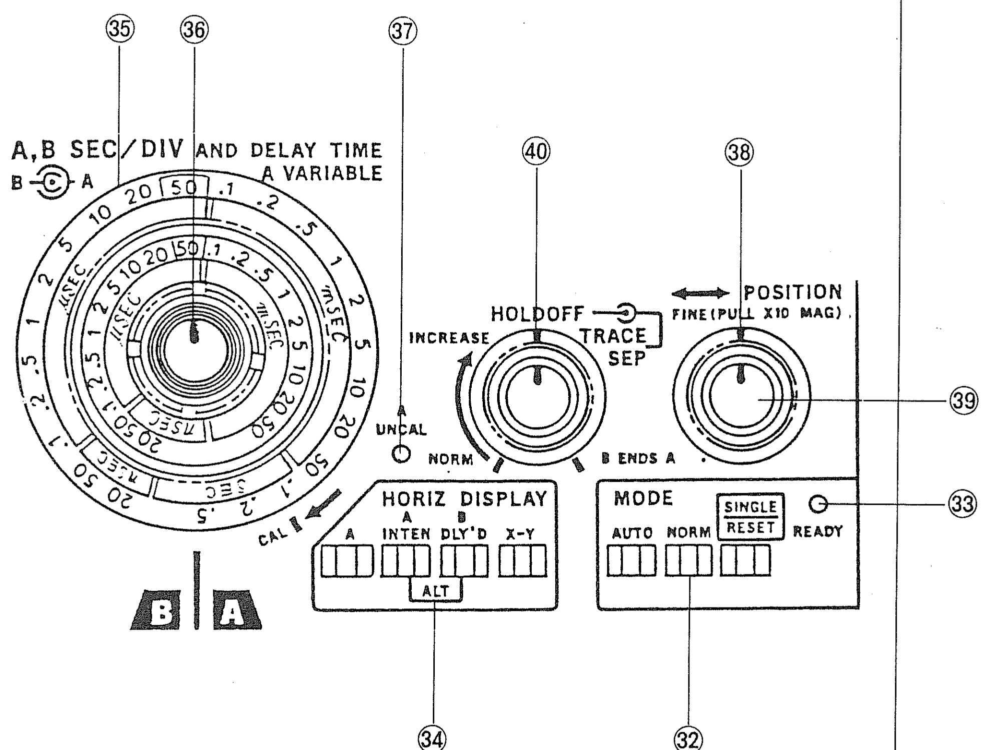
㊴ FINE (PULL x10 MAG) (inner control)

Finely moves the trace or spot horizontally. When pulled, the sweep time becomes ten times the A·B SEC/DIV value.

㊵ ↕ TRACE SEPARATION (outer control)

This control is used for moving the B-sweep waveform above the A INTEN sweep waveform on the CRT screen when the HORIZ DELAY button ALT is IN. If the control is turned fully counterclockwise, the A INTEN sweep and B-sweep waveforms overlap, and when the control is turned fully clockwise, the B-sweep waveform moves 4 divisions or more.

Figure 2-3-4. Horizontal deflection



2-3-5 CURSORS1

㊶ CURSORS1·2

Sets the cursor (1: interrupted line, 2: dotted line) movement, cursor eselection, delay time selection, comment input, date, and time.

㊷ Measurement mode by CURSOR

Used to set various measurement conditions, and select calculation and data input with the cursor.

Δt·1/Δt: H cursor display switch. When this switch is pressed, two vertical cursors appear on the screen and enable time difference, frequency, period ratio, and phase measurements. The result are displayed digitally on the screen.

ΔV: V cursor display switch. When this switch is pressed, two horizontal cursors appear on the screen and enable voltage difference, voltage ratio, and peak detection measurements. The result and displayed digitally on the screen.

Δt·ΔV: When Δt·1/Δt and ΔV keys are pressed, the vertical and horizontal cursors appear simultaneously.

RATIO/PEAK: Period ratio and peak detection measurement mode setting switch.

PHASE/%·dB: Phase difference and voltage ratio (%, dB) measurement mode setting switch.

COUNT: Frequency measurement mode, period measurement mode, and counter mode selection switch.

DATE: Date and time display on/off switch.

DATE ADJ: Date and time setting selection switch.

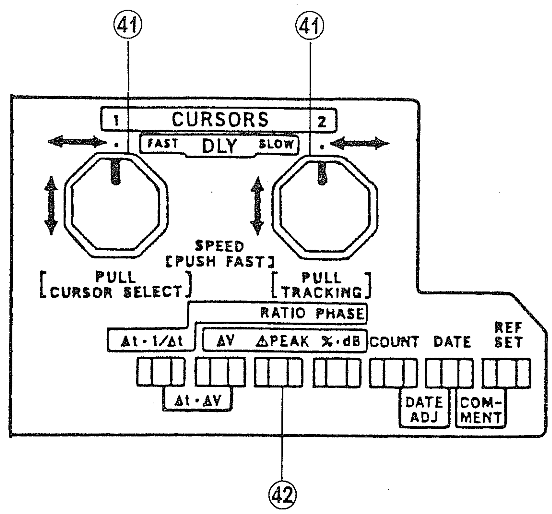
REF SET: Switch for changing the reference values for voltage ratio measurement and phase difference measurement.

COMMENT: Switch for entering comment characters.

< CAUTION >

Peak detection can be performed only when CH 1 and HORIZONTAL DISPLAY are set to A.

Figure 2-3-5. Cursors



2-4 Rear Panel

㊸ CH 1 OUT

The input signal of CH 1 is provided. The output signal is used as an input signal source for a frequency counter or others. The output voltage is 40 mV±20% per division of the graticule on the CRT screen in case of 50-ohm termination.

㊹ A GATE OUT

Provides the positive output voltage of approximately 5V synchronized with A-sweep during its period.

Output resistance is approximately 2.7 kΩ.

㊺ B GATE OUT

Provides the positive output voltage of approximately 5V synchronized with B-sweep during its period.

㊻ Z AXIS INPUT

Apply a signal for external intensity modulation to this input terminal. The maximum input voltage is 50 V (DC + peak AC). Frequency of input signal is from DC to 5MHz, input resistance is 5.1 kΩ±10%.

㊼ CAL 10 mA

A square wave current of 1 kHz, 10 mA flows through the current loop terminal in the arrow direction (from right to left). Use its current output for checking and calibrating the current probe.

㊽ ⏚ (Ground terminal for protection)

Ground terminal for protecting the oscilloscope. When supplying a line voltage from a 2-core electrical outlet, be sure to connect this terminal to the ground for preventing danger.

㊾ AC LINE INPUT

AC voltage is supplied to this connector. Connect the connector of supplied power cord to it.

㊿ A.B.C.D (Voltage Selector plug)

Set the voltage selector plug's arrow mark to one of the A, B, C or D position to suit the AC line voltage. Refer to the table of line voltage ranges.

LINE VOLTAGE RANGE

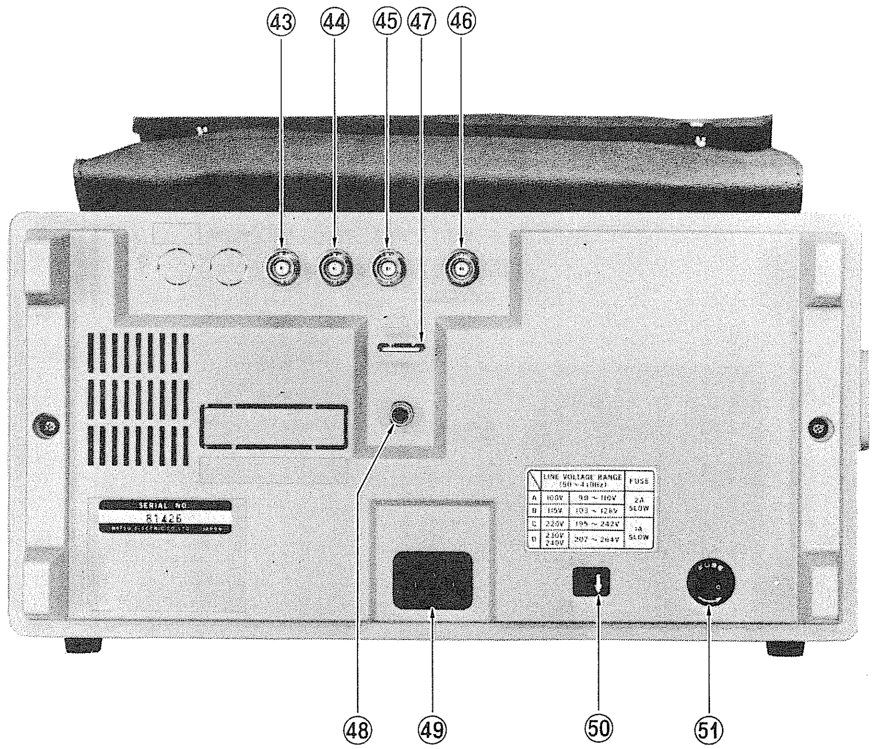
The operating voltage ranges of the AC power and the fuse specifications for each range are shown in the table.

Prior to connecting the power cord, be sure to check the supply voltage and set the voltage selector plug and fuse as shown in the table.

(51) FUSE

Fuse holder

Figure 2-4. Rear panel



2-5 BOTTOM COVER

52 GAIN

This is for adjusting vertical deflection factor.

53 X5 BAL (CH 1·CH 2)

Adjust to minimize the vertical trace movement when the vertical deflection system is set to x5 MAG.

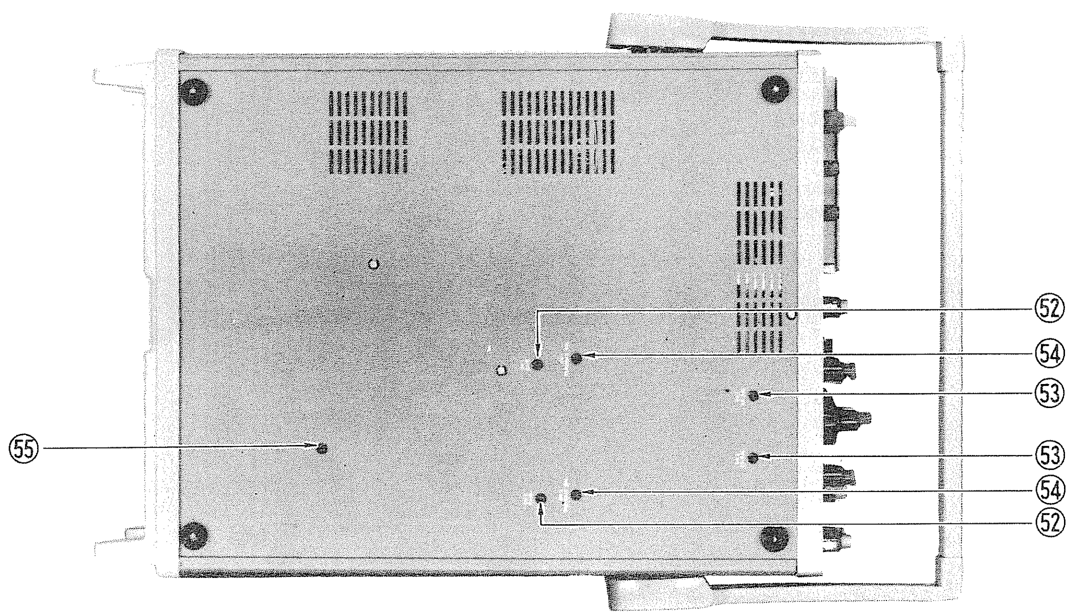
54 VARIABLE BAL (CH 1·CH 2)

Adjust to minimize the vertical trace movement when the vertical deflection system VARIABLE is turned.

55 PEAK DETECTOR

Adjust to make the cursor position equal to the wave height during peak detection measurement.

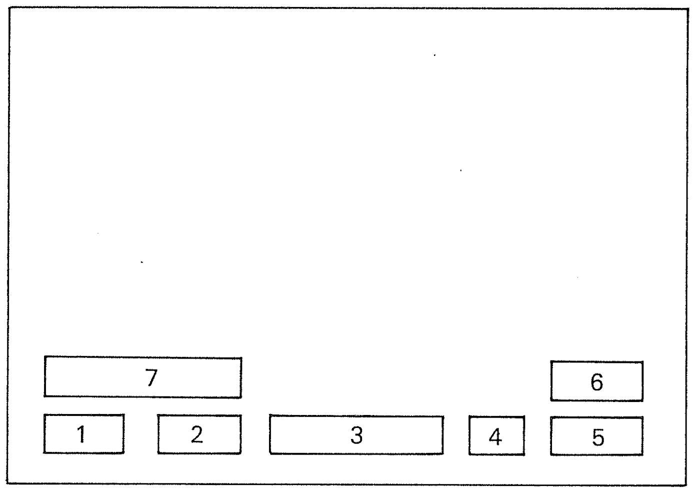
Figure 2-5. Bottom cover



2-6 READOUT DISPLAY

2-6-1 Panel Operation Setting and Symbol Display

The values selected with the switches on the front panel are displayed digitally at the following positions on the screen.



1. CH 1

Setting	Display
VOLTS/DIV	Voltage/div
VARIABLE is UNCAL	">"
x5 MAG probe 10:1	Voltage/div after conversion
Input coupling is AC	"Ṽ"
Input coupling is DC	"V"
Input coupling is GND	"⏚"

2. CH 2

Setting	Display
VOLTS/DIV	Voltage/div
VARIABLE is UNCAL	">"
x5 MAG probe 10:1	Voltage/div after conversion
Input coupling is AC	"Ṽ"
Input coupling is DC	"V"
Input coupling is GND	" ⏚ "
POLAR is INV	" ↓ "
ADD	"+"

3. CH 3, CH 4

Setting	Display
0.1 V—0.5 V	Voltage/div
Input coupling is AC	"Ṽ"
Input coupling is DC	"V"
Probe 10:1	Voltage/div after conversion

4. BANDWIDTH

- "Bw" is displayed when set to 20MHz

5. A sweep

Setting	Display
A SEC/DIV	Sweep time/div
SOURCE is CH 1	"1"
SOURCE is CH 2	"2"
SOURCE is CH 3	"3"
SOURCE is LINE	"L"
SOURCE is NORM	"N"
SLOPE is +	"+"
SLOPE is –	"–"
x10 MAG	Sweep time/div after conversion
A VARIABLE is UNCAL	">"

6. B Sweep

Setting	Display
B SEC/DIV	Voltage/div
SOURCE is CH 1	"1"
SOURCE is CH 2	"2"
SOURCE is CH 4	"4"
SOURCE is RUNS AFTER DELAY	"R"
SLOPE is +	"+"
SLOPE is −	"−"
x10 MAG	Sweep time/div after conversion

7. Cursor Selection and Tracking Status

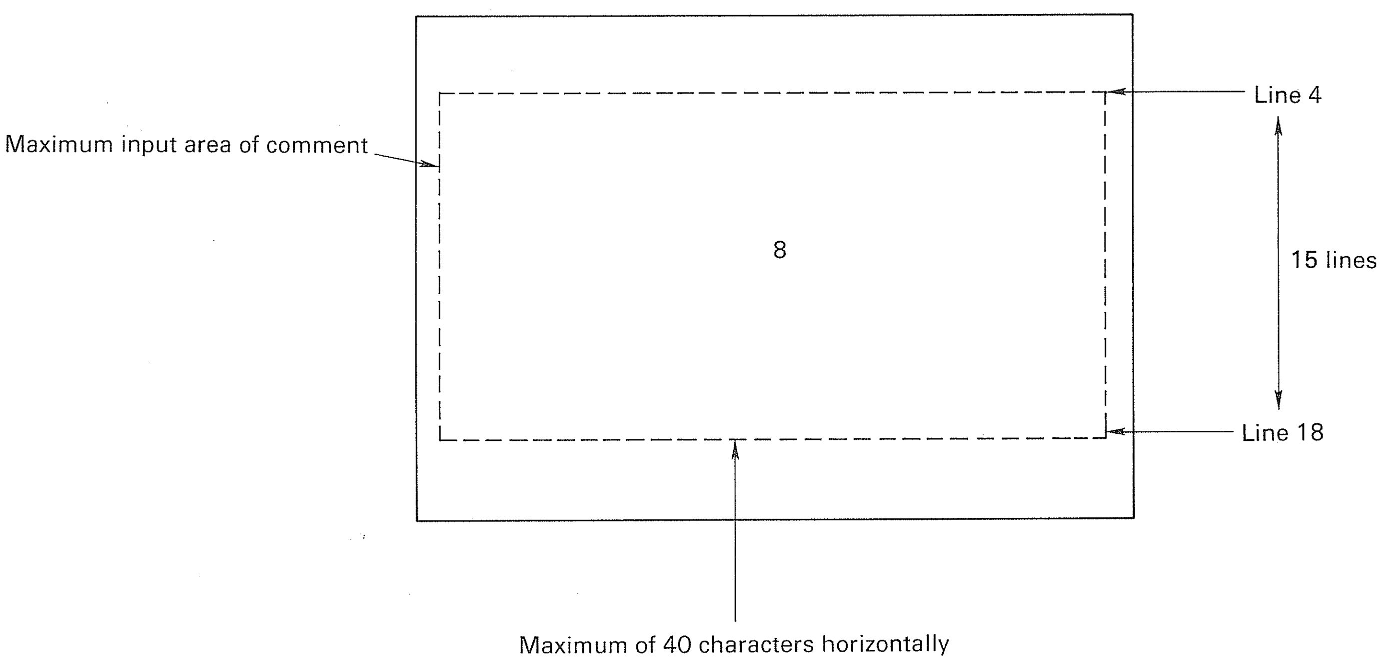
Setting	Display
H cursor movement when Δt or $1/\Delta t$	"H"
V cursor movement when ΔV	"V"
Delay time measurement	"D"
Tracking	"TRACKING"

8. Comment Input Display

Comment can be entered anywhere between line 4 and line 18 to describe measurement conditions and waveforms.

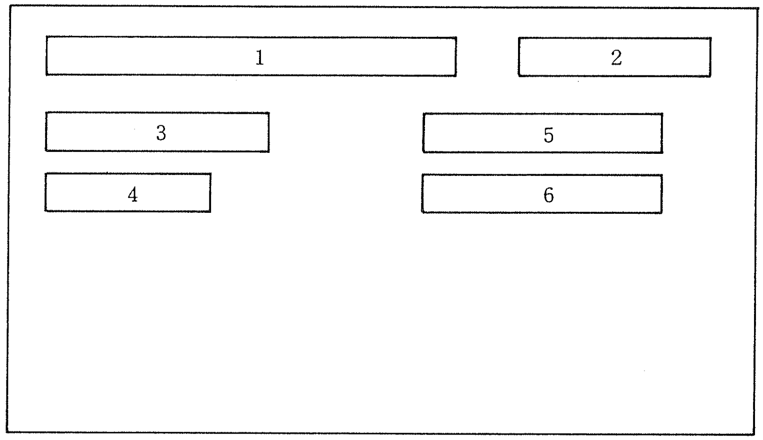
< CAUTION >

The maximum number of characters and symbols that can be entered in a comment display area is 80.



2-6-2 Measurement Value, Date, and Time Display

An internal counter enables digital display of frequency and period measurement result, cursor measurement result, and data and time at the screen locations shown below.



1. Data and Time

- " date - month - year hour: minute"

: Iwatsu logo

Date : 01 to 31
month : JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC
year : 00 to 99
time : 00 to 23
minute : 00 to 59

2. Delay Time

- The delay sweep start time is displayed with "DLY."
- When B sweep time is set slower than A sweep time, "DLY A<B" is displayed.
- The unit becomes "DIV" when A VARIABLE is set to UNCAL.
- "DLY ?" is displayed when B SOURCE is set to CH 1, 2, or 4.

3. Voltage Difference and Voltage Ratio

- The voltage is displayed as "ΔV."
- The voltage ratio is displayed as "%."
- "ΔV1" is displayed for CH 1 and "ΔV2" is displayed for CH 2.

4. Voltage Ratio (dB)

- The voltage ratio is displayed as "dB."
- The effective value (sine wave) is displayed as "RMS."

5. Time Difference, Phase Difference, and Period Ratio

- The time difference is displayed as "Δt."
  (The wave rise time measurement is displayed as "tr·tf." See section 4-2-3.)
- The phase difference is displayed as "PHASE."
- The period ratio is displayed as "RATIO."

6. Frequency

- The frequency is displayed as "1/Δt."
- The counter measured frequency is displayed as "F."
- The counter measured period is displayed as "T."

< CAUTIONS >

- When 1 and 2 above are not displayed, 3·4 and 5·6 are all moved up a line.
- The counter measured frequency is the frequency of the input signal entering the channel selected by the A SOURCE.

2-7 USING THE HANDLE AND REMOVING THE ACCESSORIES BAG

2-7-1 Operation of the Handle

The carring-handle of the SS-6122 can be unlocked if the rotary part (root) the handle is pushed inwards (in the arrow direction) as shown in Figure 2-7-1(a).

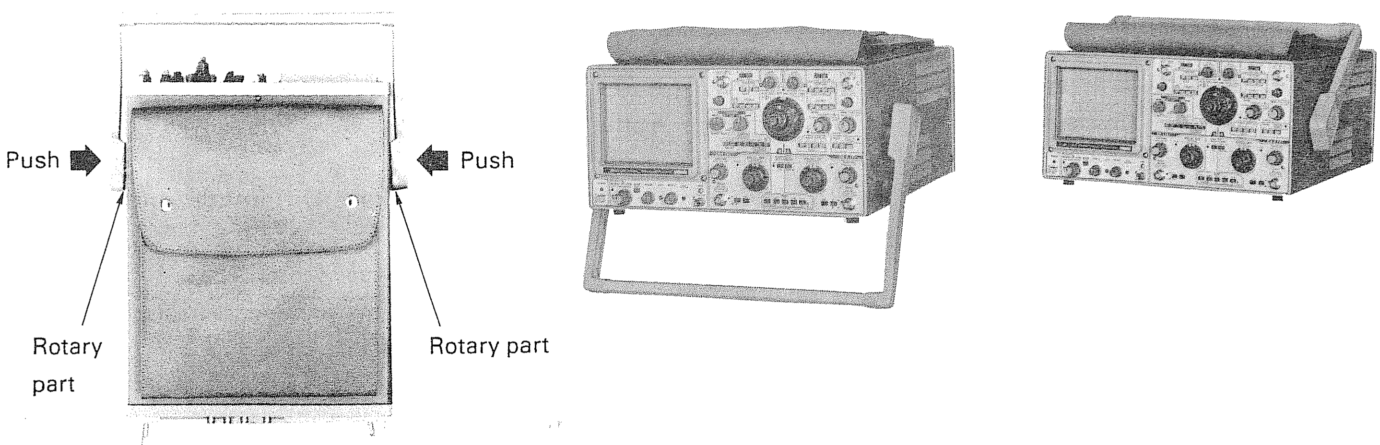
If both the right and left ends are pushed, they can be unlocked together, and the handle can be turned as it is.

If the rotary part is released, the handle is automatically locked.

The handle can be positioned as desired for carrying (as shown in Figure 2-7-1(a)) or as a stand for signal observation (as shown in Figure 2-7-1(b)).

Fold the handle back as shown in Figure 2-7-1(c), if possible, when storing the SS-6122.

Figure 2-7-1. How to place the SS-6122 and use the handle



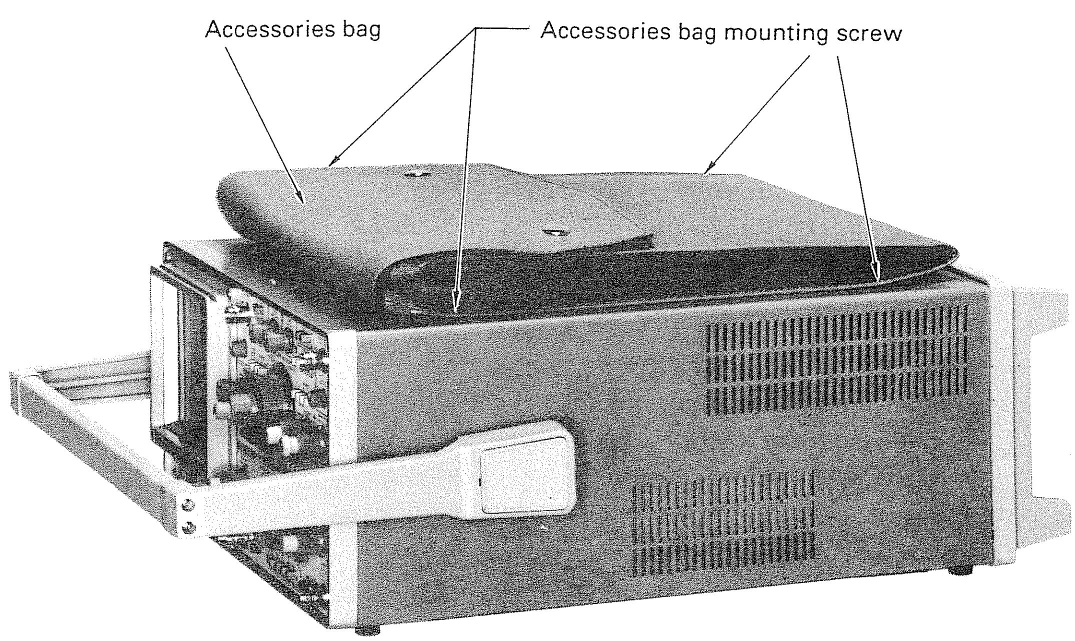
a b c

2-7-2 Removing the Accessories Bag

When removing the accessories bag from the upper cover of the SS-6122, remove the four accessories bag mounting screws shown in Figure 2-7-2.

Use the same screws for mounting the accessories bag on the upper cover again.

Figure 2-7-2. Removing the accessories bag



Section 3

Operating Instructions

3-1 DEVICE USAGE PRECAUTIONS

The basic operating instructions for the SS-6122 used for observing voltage waveforms are explaind below.

<CAUTIONS>

Ambient Temperature and Ventilation

The normal operating temperature for this instrument is −10°C to +50°C. Be sure to use it within this temperature range. If used outside this range, the instrument may malfunction.
Also, be careful not to block the ventilation openings.

Check the Power Supply Voltage

Before plugging the power cord, check the voltage of the power supply. This instrument can be used at the following voltages by setting the power supply voltage selection plug on the rear panel. Use of this instrument at any other voltage may cause it to malfunction.

Position	Center Voltage	Range	Fuse
A	100 V	90 to 110 V	2A
B	115 V	103 to 128 V	slow blow
C	220 V	195 to 242 V	1A
D	240/240 V	207 to 264 V	slow blow

Connect the Protective Ground Terminal to Ground

When plugging the power cord into 2-wire power outlet, be sure to connect the ground terminal to ground.

3-2 BASIC OPERATION FOR SIGNAL OBSERVATION

The following procedure applies where a CAL 0.6 V signal is applied to CH 1 INPUT with the supplied probe for observaton.

3-2-1 Turning POWER ON

Before connecting the connector of power cord, check the AC line voltage with a voltmeter, and set the voltage selector plug to the proper position to suit the line voltage.

1. Set the POWER to OFF position, and connect the power cord to the AC LINE INPUT connector on the rear panel and an electrical outlet.
2. Set the controls as follows.

A INTEN	Midrange
READOUT	Midrange
FOCUS	Midrange
SCALE	Approx. 45° (right)
AC-DC (CH 1)	AC
POSITION (CH 1)	Center
HORIZ DISPLAY	A
VERTICAL MODE	CH 1
SWEEP MODE	AUTO
POSITION	Midrange
FINE (PULL x10 MAG)	Midrange
A SEC/DIV	0.5 ms

3. Push the POWER button up to the ON position. A trace is displayed in about 30 seconds. Adjust its intensity as appropriately with the INTEN control.

Focusing

4. Set the A SEC/DIV switch to the 1 msec/div position, and adjust the FOCUS control to make the trace clear and sharp.

3-2-2 Applying signals and triggering

5. Set the controls as follows.

COUPLING (A-Sweep)	AC
SOURCE (A-Sweep)	CH 1
VOLTS/DIV (CH 1)	10mV/div
VARIABLE (CH 1)	CAL

6. Using the supplied probe, connect CH 1 INPUT to the CAL 0.6 V terminal.
7. Turn the LEVEL (A-Sweep) control to nearly the midrange, and a 6-division calibration voltage waveform is displayed on the CRT screen. It is triggered by internal trigger (AC coupling) in the AUTO mode.
 For a detailed description of triggering, refer to Triggering in a subsequent paragraph.

3-2-3 Deflection Factor Setting

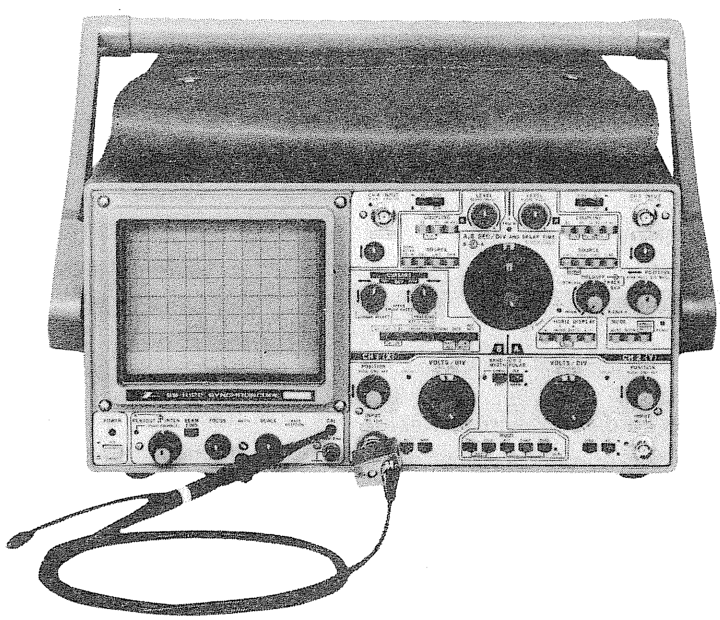
8. As VOLTS/DIV switch is turned from 10 mV, 20 mV, 50 mV, and on to 5 V, the deflection factor decreases so that the waveform amplitude on the CRT screen becomes small. The amplitude also decreases when the VARIABLE control is turned counterclockwise.
 Adjust the input deflection factor with the VOLTS/DIV switch and VARIABLE control so that the input signal has an amplitude easy to be observed on the CRT screen.

3-2-4 Sweep Rate Setting (A-Sweep)

9. As the A SEC/DIV switch is turned from 0.5 msec, 0.2 msec and on the 10 nsec, the displayed waveform that can be observed decreases. There are kinds of signals to be measured. To observe various signals on a suitable cycle, set an appropriate sweep rate with the A SEC/DIV switch and A VARIABLE control. For the sweep rate setting procedure, refer to the subsequent paragraph on sweep rate setting.

 The basic operation procedures for observing signal waveforms have been described above.

Figure 3-2-1-(1). Operating controls and switches (When CAL waveform is displayed on the CRT)



3-3 LINE VOLTAGE SELECTION

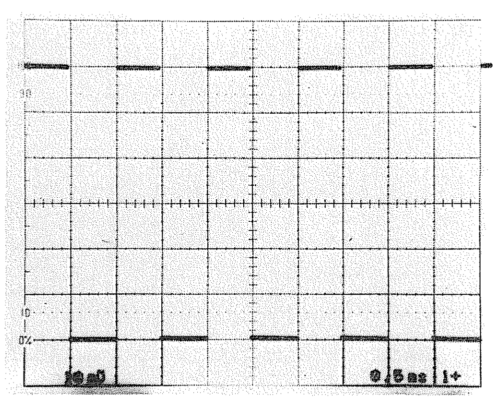
The voltage select plug on the rear panel can be pulled out and reinserted after removing the rear panel. The letters A, B, C, and D printed around the plug correspond to the letters A, B, C, and D printed on the LINE VOLTAGE RANGE plate on its left.

After checking which of the letters A, B, C, and D in the LINE VOLTAGE RANGE plate represents the primary line voltage to be applied to operate this device, reinsert the voltage select plug so that the arrow points the correct letter.

<CAUTION>

Be sure to unplug the power cord from the electrical outlet before reinserting the voltage select plug.

Figure 3-2-1-(2). Calibrator waveform



3-4 HOW TO APPLY SIGNALS (INPUT, PROBE)

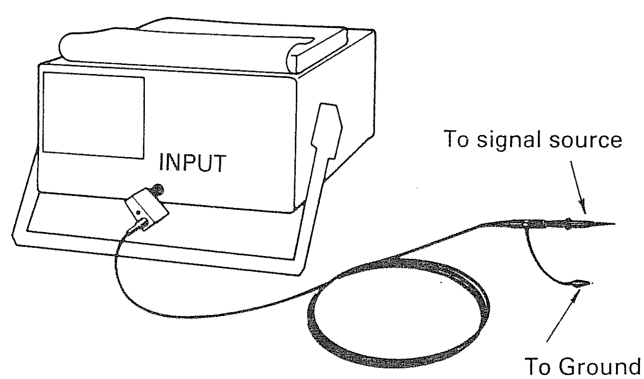
Apply signals to be measured to the INPUT connectors for channels 1, 2, 3, and 4 using a probe. The use of a probe reduces the adverse effect of external fields on the signals measure.

The SS-6122 is provided with attenuation ratios of 10 to 1 probe as an accessory.

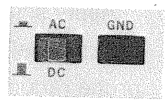
Input impedance is higher when the probe is used at the attenuation ratio of 10 to 1 than when it is used at the attenuation ratio of 1 to 1 (option) or when the probe is not used so that the load effect on the signal source is reduced. Even if the signal source has a relatively high impedance, therefore, signals can be measured accurately.

If the probe is used at 1 to 1 in measuring high-frequency signals, a large load effect will be produced on them. That is, the use of the probe at the attenuation ratio of 1 to 1 is suitable for measuring low-frequency, low-level signals.
(For detailed information on the probe, refer to the instruction manual for the probe.)

Figure 3-4. Example of probe connection



3-5 INPUT COUPLING SELECTION (AC - DC, GND)



There are many types of signals to be measured, including DC, AC, and AC superimposed on DC signals. To correct measure these signals, it is necessary to select the proper signal input coupling, using the AC - DC switch. This switch is used for selecting a type of signal input coupling for the vertical axis. When the switch is pressed to the AC position, the AC coupling in which the INPUT connectors are connected via a capacitor to the input of the vertical amplifier is selected. If the switch is released to the DC position, the DC coupling in which the INPUT connectors are directly connected to the vertical amplifier is selected. When pushing the GND switch, the input signal is not connected to the vertical amplifier, whose input section is thus grounded.

AC Coupling

When the AC-DC switch is pressed to the AC position, only the AC signal component of superimposed on DC signal input is allowed to pass, while the DC signal component is blocked by the capacitor. Even if the deflection factor is raised, therefore, the AC signal waveform will not be moved out of the CRT screen by the DC (signal offset), but can be observed with itw amplitude magnified on the screen. If a signal with a low repetition frequency is observed in the AC coupling mode, a sag occurs if the signal is a square wave, or the signal is shown attenuated in amplitude. This attenuation is about-3dB per 4 Hz.

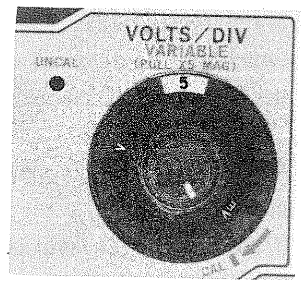
DC Coupling

When the AC-DC switch is released to the DC position, all the frequency components of the input signal are allowed to pass. Normally, this mode should be used except when blocking the DC components of the input.

GND (FREERUN)

With the GND switch ON, the input section of the vertical amplifier is grounded and thus the trace of the ground potential is displayed on the screen. This potential is usually used as the reference potential for measurement.

3-6 DEFLECTION FACTOR SETTING (VOLTS/DIV, VARIABLE)



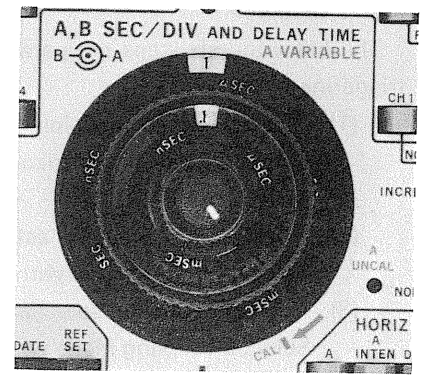
To display and measure a signal on the CRT screen, it is necessary to show it in an appropriate amplitude on the screen. Correct measurement cannot be expected if the amplitude on the CRT screen is too small or so large that it extends beyond the limits of the screen. Therefore, the deflection factor must be increased if the input signal has too small an amplitude, or decreased if it has too large an amplitude. The switches for channels 1 and 2 VOLTS/DIV, which have a fine control called VARIABLE are used for varying the deflection factor.

If the VARIABLE control is turned fully clockwise to the CAL position, the deflection factor is directly indicated by the VOLTS/DIV switches.

VOLTS/DIV indications represent voltages per division of the amplitude of a signal waveform displayed on the CRT screen. Turning VARIABLE counterclockwise decreases the deflection factor. When VARIABLE is fully turned counterclockwise, each position represents 1/2.5 (or less) of the value indicated.

The deflection factor for channel 3 and 4 are fixed at 0.1 V/div and 0.5 V/div. No fine control is proviced for channel 3.

3-7 SWEEP RATE SETTING (A. B SEC/DIV, VARIABLE)



Signals to be measured may include a lowfrequency signal, high-frequency signal, and a pulse with a slow rise or quick rise. It is necessary to select a sweep rate suitable to the signal to be measured.

Lower the sweep rate when measuring, for example, a low-frequency signal, or a pulse with slow repetition, and raise the sweep rate when measuring, for example, a high-frequency signal, or a pulse with a quick rise.

The switch for sweep rate selection in sweep A is A SEC/DIV, which has a fine control called A VARIABLE.

When the A VARIABLE control is fully turned clockwise to the CAL position, the A SEC/DIV switch directly indicates a sweep rate. Turning the A VARIABLE control counterclockwise lowers the sweep rate. When it is fully turned counterclockwise, each position represents 2.5 times or less of the value indicated.

The switch for sweep rate selection in sweep B is B SEC/DIV, which has no fine control.

3-8 TRIGGERING

The operation for displaying a signal to be measured still on the CRT screen is called triggering. It is described in this section.

The following six steps of operation are necessary for triggering.

(1) Trigger mode selection
Select either the horizontal MODE AUTO or NORM.

(2) Trigger signal source selection
Select a trigger signal with SOURCE.

(3) Trigger coupling selection
Select a coupling mode with COUPLING.

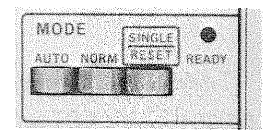
(4) Slope selection
Push LEVEL for positive trigger slope or pull it for negative trigger slope.

(5) Trigger level selection
Select a suitable trigger level in the trigger level range.

(6) Hold-off adjustment
This adjustment is made for stabilized triggering of the waveform of a complex pulse line.

3-8-1 Trigger Mode Selection (MODE)

The SS-6122 has three trigger modes: AUTO, NORM, and SINGLE/RESET. Each of which can be selected with the horizontal MODE buttons.

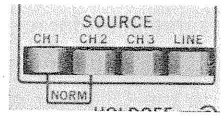


AUTO: A desired trigger level can be set with the LEVEL control.
If the set trigger level is within the trigger level range (see 3-8-4 Slope Selection), the input signal is triggerd.
If the set trigger level is outside the trigger level range, or if no trigger signal is available, a free running sweep takes place.
Therefore, a signal too small to provide sufficient amplitude can be easily checked, and the ground potential can be easily confirmed by grounding the input.
Input signals of 50 Hz or below will not be synchronized.
In this case, use the NORM mode mentioned below.

NORM: If the set trigger level is within the trigger level range, the input signal is synchronized as in the AUTO mode, but if it is outside the trigger level range or if no trigger signal is available, there will be no sweep.

SINGLE: Only a single sweep takes place. When the SINGLE/RESET button is pressed once, the device stands by for the start of a sweep. If the same button is pressed again when the input signal is synchronized ans when the LED of A TRIG'D is lighted, a single sweep takes place.
This mode is used when photographing waveforms on the CRT screen or observing attenuated waveforms.

3-8-2 Trigger Signal Source Selection (SOURCE)



Triggering requires applying an input signal, or a signal which has a specific time relationship (an integer or times an integer) with the input signal (called a trigger signal), to the trigger circuit to drive it to generate a trigger pulse and drive the sweep circuit with it.

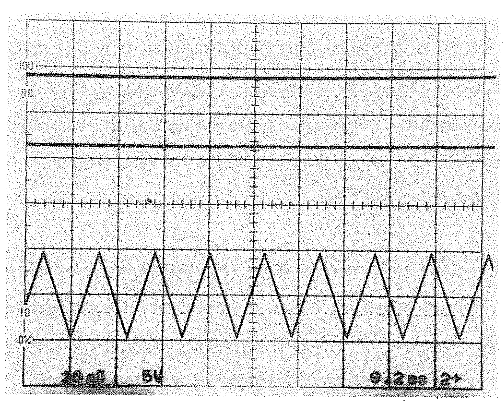
The method of applying the input signal applied to INPUT to the trigger circuit via internal circuits (half way in the vertical deflection system) is called Internal Trigger.

Internal Trigger is selected when SOURCE is set to CH 1 or CH 2. In Internal Trigger, an input signal is internally connected to the trigger circuit when it is half way in the vertical deflection system. Thus, if it is directly applied to INPUT, though it may be a low-voltage input signal, it is amplified to an appropriate voltage level, and automatically routed to the trigger circuit.

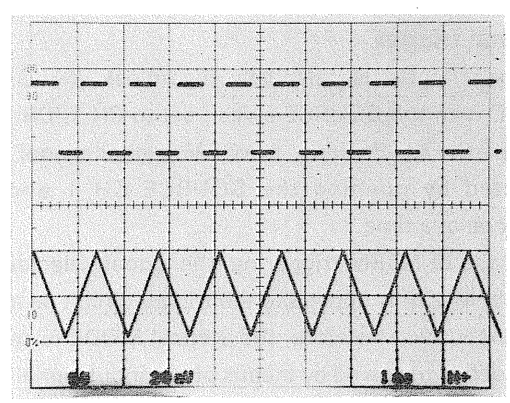
This means simple operation and no need for lowering the output impedance of the trigger signal source as in External Trigger. Internal Trigger is normally more convenient than External Trigger for these advantages. To select a trigger signal for Internal Trigger, set SOURCE to CH 1 so that the input signal that is applied to the INPUT connector for channel 1 is routed to the trigger circuit. If SOURCE is set to CH 2, the input signal that is applied to the INPUT connector for channel 2 is routed to the trigger circuit. In measuring two input signals of the same frequency, selection of the channel to which the input signal that has the higher voltage and less noise than the other is applied provides higher trigger stability.

In measuring two input signals having different frequencies as shown in Figure 3-8-2, it is necessary to select the channel to which the input signal of the lower frequency is applied (provided that their relationship is that of times an integer). If the other channel is selected, the waveform of the input signal that has the lower frequency will not be triggered. In the case shown in Figure 3-8-2, for example, a pulse must be used for triggering. If a sawtooth wave is used for this purpose, a pulse wave cannot be triggered. In measuring a phase difference, it is necessary to select the channel to which the signal that has the advanced phase is applied.

Figure 3-8-2. Triggering signals of different frequencies



Trigger by sawtooth wave



Trigger by square-wave

The method of applying an external input signal or a signal having a specific time relationship with the input signal to the trigger circuit is called External Trigger.

If SOURCE is set to CH 3 and if a signal that has a time relationship with the signal applied to the INPUT connector for channel 1 or 2 is applied to the INPUT connector for channel 3, the input signal applied to the INPUT connector for channel 1 or 2 can be triggered by the input signal to channel 3. Also, quantitative measurement is possible by displaying the input signal on the CRT screen. The advantages of Internal Trigger are directly the disadvantages of External Trigger, but External Trigger provides the following advantages that can hardly be disregarded.

First, External Trigger is unaffected by the vertical deflection system. In Intertal Trigger, the voltage applied to the trigger circuit varies as VOLTS/DIV is turned. In the sweep mode NORM, however, LEVEL must be adjusted each time VOLTS/DIV is turned depending on the input signal waveform. In External Trigger, however, accurate triggering is assured once satisfactory triggering is obtained no matter how the VOLTS/DIV switch is turned unless the external trigger signal waveform changes.

Second, if a sweep is desired a specific time before or after an input signal waveform appears, and if a signal is obtained at the point before or after that specific time, this signal may be applied to the INPUT connector for channel 3 for measuring the input signal waveform.

Normal trigger

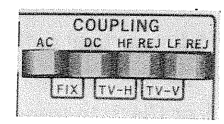
Trigger signal is selectable regardless of the vertical MODE with the SOURCE switch set to CH 1/CH 2/CH 3 (except CH 4). Besides, a NORM trigger signal can be selected by pushing the SOURCE CH 1 and CH 2 switches at a time.

In case of NORM triggering, the signal selected in the vertical MODE is applied to the trigger circuit as a trigger signal source. Therefore, the vertical MODE is set to CH 1, sweep is triggered by means of the input signal applied to the CH 1 INPUT. Similarly, the vertical MODE is to CH 2, sweep is triggered by the input signal applied to the CH 2 INPUT.

When the vertical MODE is set to ALT, the trigger signal is possible to change according to the display on the screen. Under this state, any waveform starts at the same point for easy pulse width comparison.

Incidentally, when the SOURCE switch is set to NORM in the CHOP or ADD of the vertical MODE, triggering is generally unstable. In this case, select a trigger signal source of SOURCE CH 1, CH 2, or CH 3 only.

3-8-3 Trigger Coupling Selection



Use COUPLING to select a trigger signal input circuit coupling mode.

The purpose of it is to stably triggering an AC signal, DC signal, or a signal superimposed on harmonic noise and display its waveform on the CRT screen.

AC: This mode puts the trigger circuit in AC coupling, in which only the AC component of the trigger signal is used for triggering. Because the DC component of the trigger signal is cut off, synchronization can be established regardless of the DC component of the trigger signal.
AC coupling is generally convenient except when the trigger signal has a freuqency below 30 Hz, in which case it is difficult to trigger.

DC: This mode puts the trigger circuit in DC coupling, in which a DC may be used for triggering. If an AC signal is superimposed or the DC trigger signal, or if its DC voltage is outside the range set with the LEVEL control, it cannot be used for triggering.

HF REJ: In this mode, the trigger circuit is coupled via the lowpass filter. A high-frequency trigger signal (about 10 kHz or over) or high frequency noise which is superimposed on the trigger signal is attenuated by the filter which passes only low-frequency component of the trigger signal.

LF REJ: The trigger circuit input comprises a high pass filter which rejects low-frequency trigger signals (over about 10 kHz) and low-frequency noises which is superimposed on the trigger signals, and passes only high-frequency components.

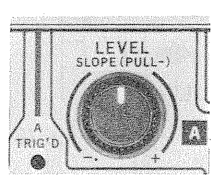
FIX: With the AC switches pushed at a time, FIX is set. By this coupling method (AC coupling), the trigger level is fixed to about 0 V, and no LEVEL adjustment is therefore required. Thus, when a trigger signal exceeding a given level is applied, triggering occurs automatically.
The operation for triggering is very simple. But since the trigger level is fixed, it cannot be set to the desired value. The minimum amplitude required for triggering depends on the frequency as follows:
100 Hz to 10 MHz: 1 division or more (For sine waves)
10 MHz to 50 MHz: 2 division or more (For sine waves)

TV-H: TV-H function is selected when both DC and HF REJ buttons are simultaneously pushed in. Use a television horizontal synchronization pulse for triggering in observing signals over a period of 1H.

TV-V: TV-V function is selected when both HF REJ and LF REJ buttons are simultaneously pushed in. Uses a television vertical synchronization pulse for triggering in observing composite video signals over aperiod of 1V.

3-8-4 SLOPE Selection (SLOPE)

Select either positive for the trigger signal to be used for triggering. Push LEVEL in for selecting positive slope, or pull it for selecting negative slope.



3-8-5 Trigger level selection (LEVEL)

Trigger level must be set within the specified trigger level range (refer to Figure 3-8-5) for proper triggering. Proper trigger condition is indicated by the lighting of the LED of A TRIG'D.

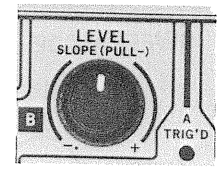


Figure 3-8 shows trigger levels set when the positive and negative trigger slopes are selected by use of the LEVEL control.

The four waveforms on the CRT screen start sweeping at the trigger level position selected with the LEVEL control.

Figure 3-8-4. Trigger signal slope

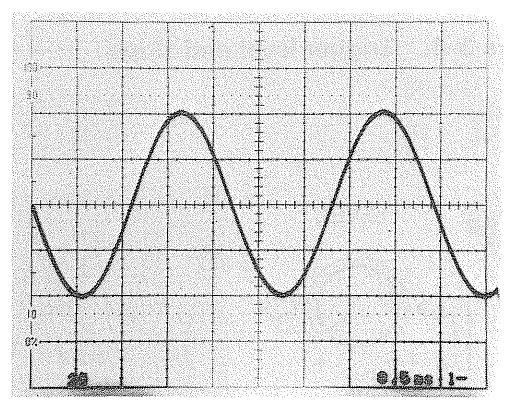


Figure 3-8-5. Trigger level

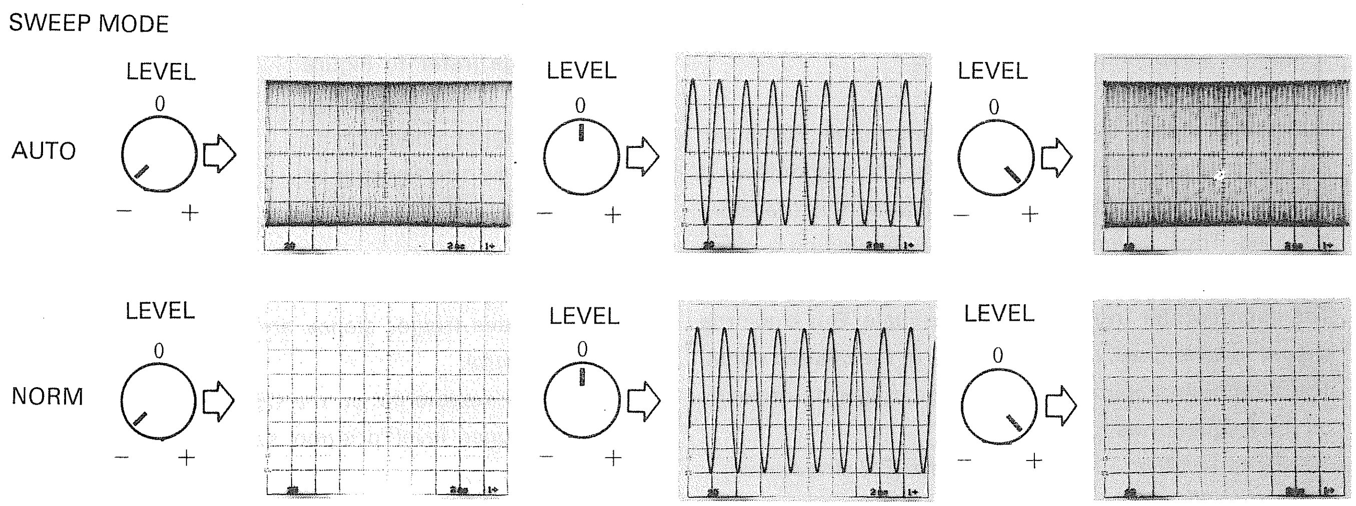
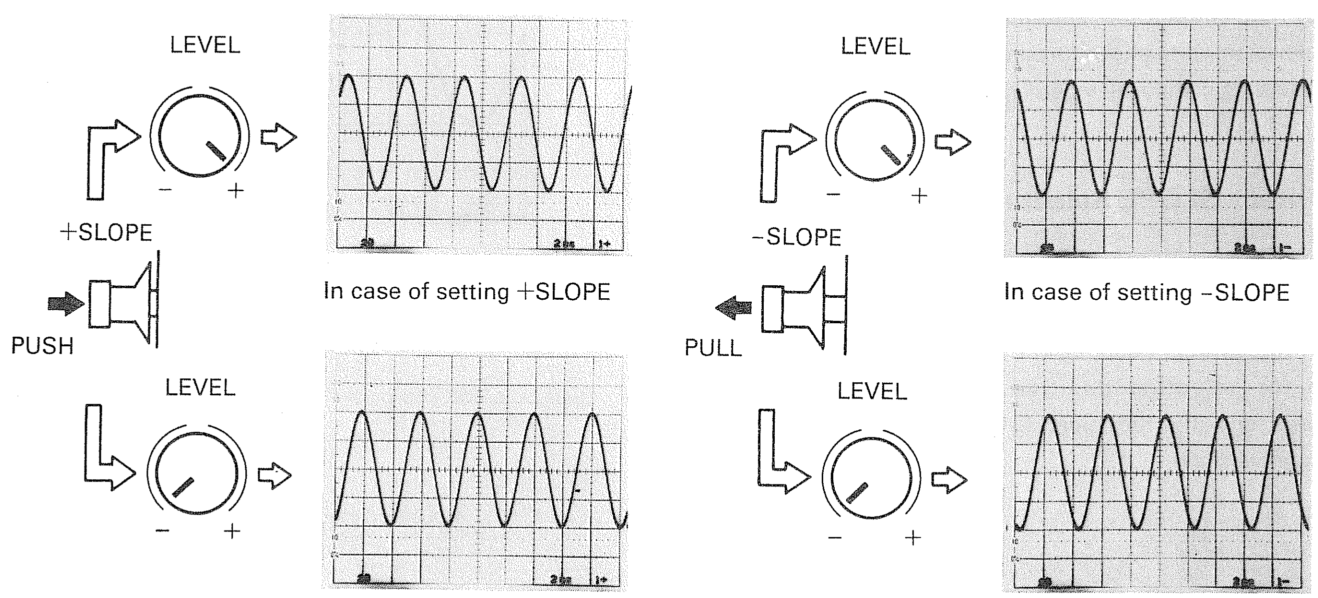
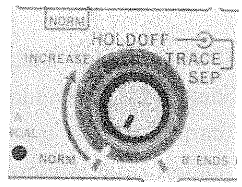


Figure 3-8. Trigger level and slope



3-8-6 HOLD OFF

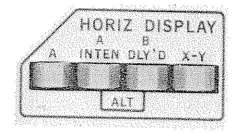


In observing the waveform of a complex line of pulses, the waveform may appear doubled despite synchronization depending on sweep rate setting.

In such a case, fully turn the HOLD OFF control from the counterclockwise extremity in the direction of INCREASE to adjust the sweep cycle so that the sweep always starts on the basic cycle of the signal. The waveform then appears in a way easy to observe.

By setting the HOLDOFF switch to "B ENDS A" and the HORIZ DISPLAY switch to A INTEN, ALT, or B (DLY'D), A sweep and B sweep are completed at the same time. This prevents reduction of the light intensity during high-magnification delay sweep.

3-9 HORIZONTAL AXIS OPERATION SELECTION



Select a horizontal axis sweep mode.

A: The A-sweep circuit is used for sweep. A sweep rate can be selected with the A SEC/DIV and VARIABLE.

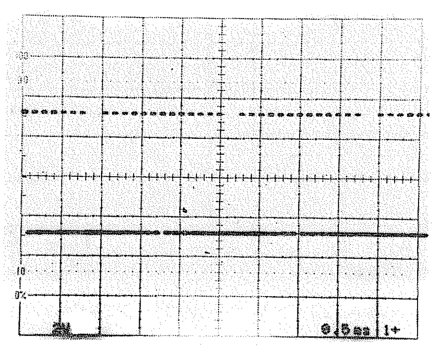
A INTEN: The B-sweep is intensity-modulated and displayed on the A-sweep to check the start position of the B-sweep (delay sweep) and sweep length. A sweep rate can be selected with the A SEC/DIV and B-sweep width (sweep rate) with the B SEC/DIV.

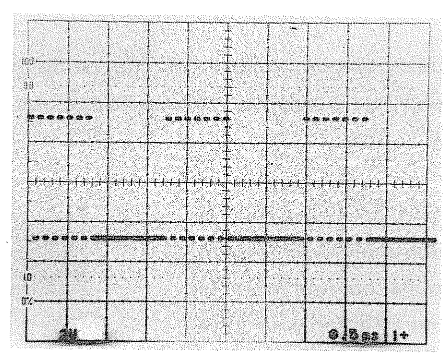
ALT: In this mode, A INTEN sweep alternates with B sweep.

B (DLY'D): In this mode, the portion (B sweep time) intensity-modulated in A INTEN sweep is displayed fully on the screen. The sweep time is set with the B SEC/DIV switch. (Figure 3-10)

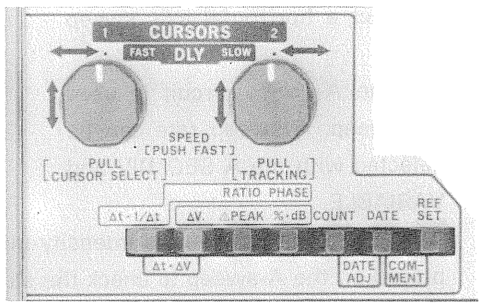
X - Y: The SS-6122 operates as a X - Y scope. In this mode, the input signal applied to the CH 1 INPUT is deflected horizontally and the input signal applied to the CH 2 INPUT is deflected vertically.

Figure 3-8-6. Example of measuring complex pulse train





3-10 TRIG'D RUNS AFTER DELAY, and DELAY TIME MULTI



The delay sweep function is used to display magnified a part of the signal to be measured a specific time after the sweep start point.

The A SEC/DIV and DELAY TIME are used for delay time setting, and the A.B SEC/DIV for magnification selection.

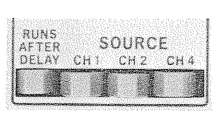
If an A-sweep of 1 ms/division, for example, is selected in Figure 3-10, a delayed sweep starts 5.7 divisions after the start point of the A-sweep. Thus, 1 ms/division × 5.7 divisions = 5.7 ms.

If a B-sweep of 50μs/division is selected, the magnification ratio will be

$$\frac{1 \text{ ms/division}}{50\ \mu\text{s/division}'}$$

that is, 1 to 20.

Two delay sweep modes, i.e., Trigger Delay and Runs After Delay, are available, and can be selected with the B SOURCE button.



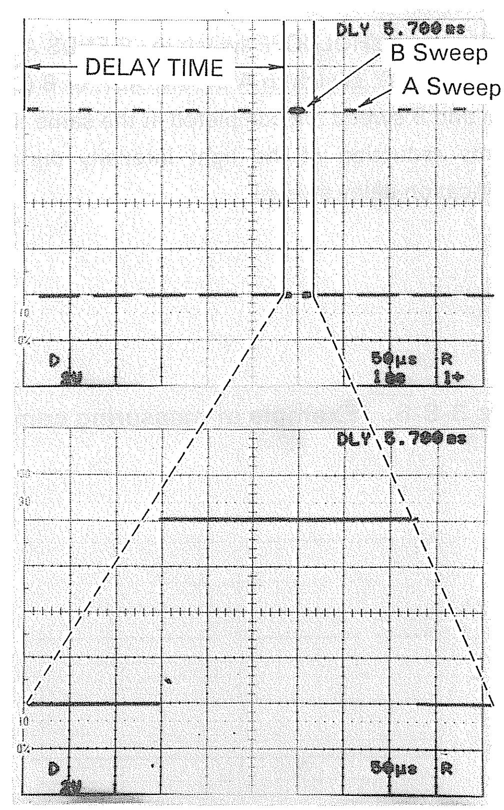
TRIG'D (CH 1, CH 2, CH 4): B-sweep is triggered by the first trigger pulse coming after the delay time selected with the A SEC/DIV and DELAY TIME

This mode is used if delay jitters appear in the waveform on the CRT screen in the RUNS AFTER DELAY mode which is described below.

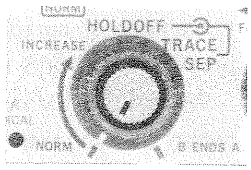
If a regularly repeating sine wave or square wave is provided, the waveform may appear still even through the DELAY TIME is turned, but delay time changes.

RUNS AFTER DELAY: Delay time can be selected as desired. THis mode offers the advantage that a B-sweep can be started at any point of an A-sweep. If the magnification ratio is increased so much, however, delay jitters appear on the CRT screen.

Fugure 3-10. Example of delay sweep display—



3-11 TRACE SEPARATION

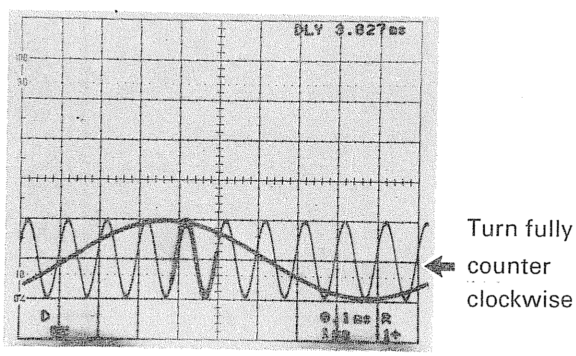


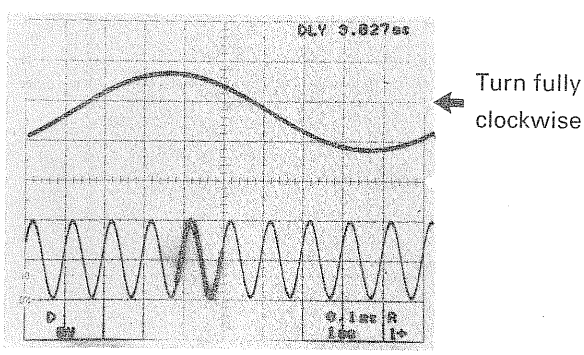
This function is effective only when the A HORIZ DISPLAY mode ALT is selected.

Waveforms displayed by the A INTEN sweep and B-sweep functions can be separated in the vertical direction.

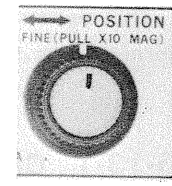
When the control is fully turned counterclockwise, the waveforms displayed by the A INTEN sweep and B-sweep functions appear overlapped. When the control is turned clock-wise, the waveform displayed by the B-sweep function moves.

Figure 3-11. Waveform display by TRACE SEPARATION





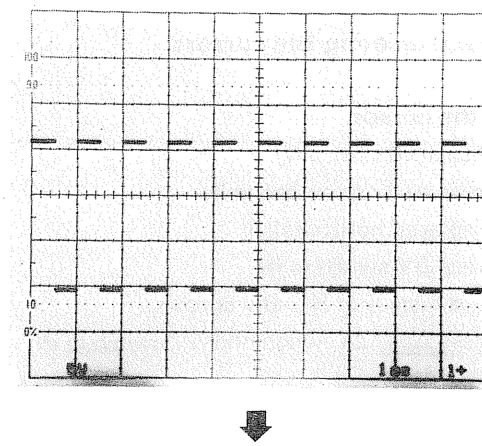
3-12 FINE (PULL x10 MAG)

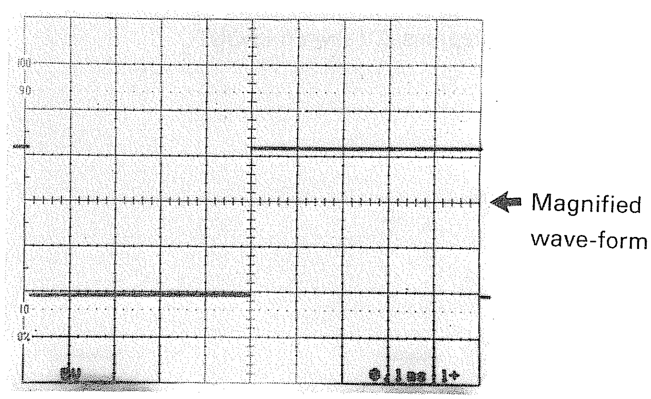


Waveforms shown on the CRT screen can be horizontally magnified ten times.

Waveforms are horizontally magnified from the center of the graticule on the CRT screen so, first adjust the waveform to the center of the graticule with the ◄► POSITION control and next, pull the FINE control.

Figure 3-12. Example of waveform display by FINE (PULL x10 MAG)





3-13 CURSOR OPERATION

This section describes how to use the cursors to perform various measurements.

3-13-1 Cursors 1 and 2

A set of two parallel cursors are displayed horizontally and vertically. Voltage difference, voltage ratio, time difference (period), and phase difference can be measured by moving the two vertical and horizontal cursors with CURSORS 1 and 2 controls so that they enclose the area to be measured. In addition, the CURSORS 1 and 2 controls can be used to select the delay time, set the date and time, and to enter comments.

Displaying and deleting the cursors

Displaying the cursor

H cursor (displayed vertically):
    Depress Δt·1/Δt switch to IN
V cursor (displayed horizontally):
    Depress ΔV switch to IN
Simultaneous display of H and V cursors:
    Depress Δt·1/Δt switch and ΔV switch to IN

Deleting the cursor

H cursor: Depress Δt·1/Δt switch to OUT
V cursor: Depress ΔV switch to OUT

Moving the Cursors

The displayed cursors can be moved horizontally or vertically by turning the CURSORS 1 and 2 controls. The movement of cursors 1 and 2 can be accelerated by pressing CURSORS 1 and 2 controls while turning.

When H and V cursors are displayed simultaneously (when Δt·1/Δt and ΔV switches are depressed), "V" and "H" are displayed alternately in the readout display position 7 when the CURSORS 1 control is pulled. The V cursor moves when "V" is displayed and the H cursor move when "H" is displayed.

When CURSORS 2 control is also pulled, the word "TRACKING" is displayed in readout display position 7. When "TRACKING" is displayed, a pair of cursors move simultaneously when CURSORS 1 control is turned and only cursor 2 moves when CURSORS 2 control is turned. The above is summarized in table 3-13-1.

SS-6122 Section 3 Operating Instructions

Table 3-13-1

<table>
<tr><td colspan="2">HORIZ DISPLAY</td><td colspan="8">A, X - Y</td><td colspan="11">A INTEN, B DLY'D</td></tr>
<tr><td colspan="2">Status of Δt·1/Δt switch</td><td colspan="2">Δt·1/Δt switch depressed</td><td colspan="2">Δt switch depressed</td><td colspan="4">Δt·1/Δt and ΔV switches depressed</td><td colspan="3">Δt·1/Δt switch depressed</td><td colspan="3">ΔV switch depressed</td><td colspan="5">Δt·1/Δt and ΔV switches depressed</td></tr>
<tr><td rowspan="4">CURSORS 1</td><td>Display due to control operation</td><td colspan="2">H</td><td colspan="2">V</td><td colspan="4">H ⟷ V</td><td colspan="3">H ⟷ D</td><td colspan="3">V ⟷ D</td><td colspan="5">→ V → H → D</td></tr>
<tr><td>Displayed character</td><td colspan="2">H</td><td colspan="2">V</td><td colspan="2">H</td><td colspan="2">V</td><td colspan="2">H</td><td>D</td><td colspan="2">V</td><td>D</td><td colspan="2">V</td><td colspan="2">H</td><td>D</td></tr>
<tr><td>TRACKING display *1</td><td>No</td><td>Yes (H TRACKING)</td><td>No</td><td>Yes (V TRACKING)</td><td>No</td><td>Yes (H TRACKING)</td><td>No</td><td>Yes (V TRACKING)</td><td>No</td><td>Yes (H TRACKING)</td><td>–</td><td>No</td><td>Yes (V TRACKING)</td><td>–</td><td>No</td><td>Yes (V TRACKING)</td><td>No</td><td>Yes (H TRACKING)</td><td>–</td></tr>
<tr><td>Cursor movement</td><td>H cursor 1 only</td><td>H cursors 1 and 2</td><td>V cursor 1 only</td><td>V cursors 1 and2</td><td>H cursor 1 only</td><td>H cursors 1 and 2</td><td>V cursor 1 only</td><td>V cursors 1 and2</td><td>H cursor 1 only</td><td>H cursors 1 and 2</td><td>–</td><td>V cursor 1 only</td><td>V cursors 1 and2</td><td>–</td><td>H cursor 1 only</td><td>H cursors 1 and 2</td><td>V cursor 1 only</td><td>V cursors 1 and2</td><td>–</td></tr>
<tr><td rowspan="2">CURSORS 2</td><td>Display due to control operation</td><td colspan="10">TRACKING
Switch between displayed ⟷ not displayed</td><td>—</td><td colspan="2">TRACKING
Switch between displayed ⟷ not displayed</td><td>—</td><td colspan="4">TRACKING
Switch between displayed ⟷ not displayed</td><td>—</td></tr>
<tr><td>Cursor movement *2</td><td colspan="2">H cursor 2</td><td colspan="2">V cursor 2</td><td colspan="2">H cursor 2</td><td colspan="2">V cursor 2</td><td colspan="2">H cursor 2</td><td>Change in delay time</td><td colspan="2">V cursor 2</td><td>Change in delay time</td><td colspan="2">V cursor 2</td><td colspan="2">H cursor 2</td><td>Change in delay time</td></tr>
</table>

*1: Shows whether "TRACKING" is displayed or not depending on CURSOR 2 control operation.

*2: Delay time is changed when D is displayed. However, it cannot be changed when DLY A < B.

3-13-2 Time Difference (Δt) and Frequency ($1/\Delta t$)

Time difference period measurement is the measurement of time from one point on the screen to another and is expressed in "s."

Frequency is the reciprocal of time difference and is expressed as "Hz."

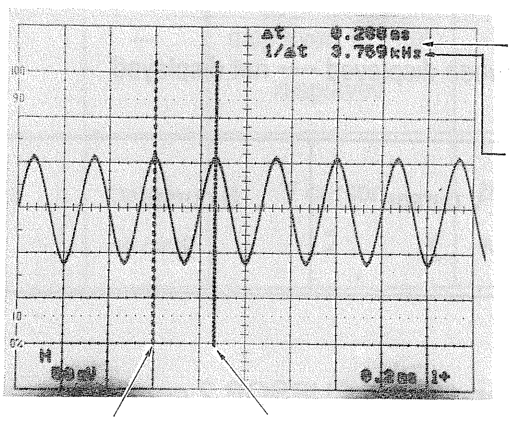
The time difference (period) between two cursors and its reciprocal (frequency) are measured.

For Δt, the result is displayed as a negatime value when cursor 2 is to the left of cursor 1.

Procedure

1. Depress the $\Delta t \cdot 1/\Delta t$ swtich.
2. Enclose the two points to be measured with the H cursors. The measured result is displayed digitally. (See Figure 3-13-2.)

Figure 3-13-2. Time difference and frequency measurement



3-13-3 Phase Difference

First, a predefined reference value (5 div = 360° for this instrument) or an interval enclosed by two cursors is defined as 360°. Next, the phase between the cursors is measured in degrees.

The sign is positive "+" when cursor 1 is to the left of cursor 2 and negative "−" when cursor 2 is to the left of cursor 1.

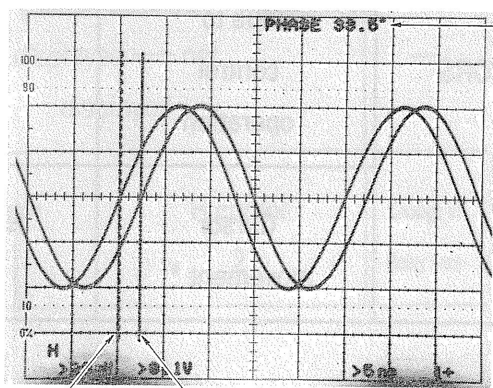
Procedure for measurement from a reference value

1. Depress the $\Delta t \cdot 1/\Delta t$ switch.
2. Depress the PHASE switch.
3. Enclose the two points to be measured with H cursors. (See Figure 3-13-3.)

Procedure when an arbitrary interval is defined as 100%

1. Depress the $\Delta t \cdot 1/\Delta t$ switch.
2. Depress the PHASE switch.
3. Set H CURSORS 1 and 2 to two arbitrary points.
4. Depress the REF SET switch. The interval between the two points set in step 3 becomes the reference value (100%).
5. Enclose the two points to be measured with the cursor. The measured result is displayed digitally.

Figure 3-13-3. Phase difference measurement—



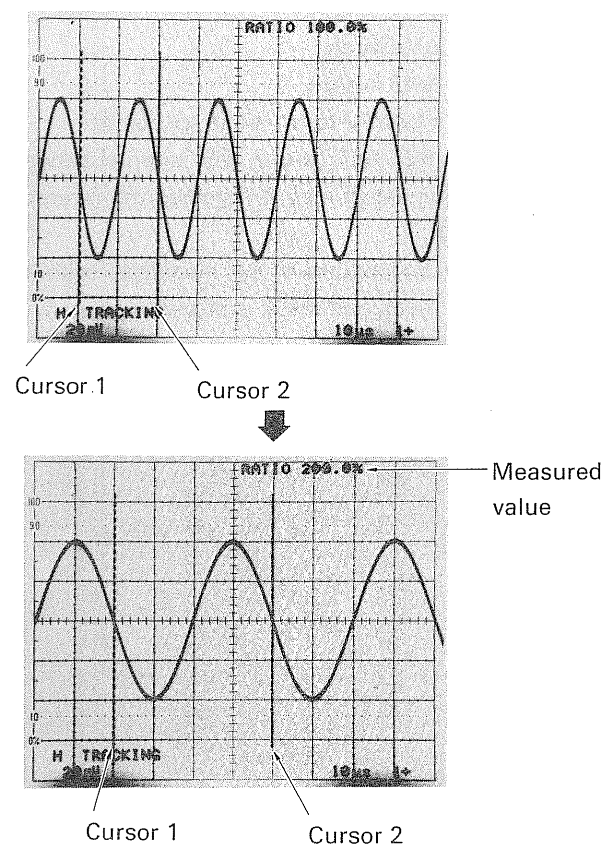
3-13-4 Period Ratio (RATIO)

When a period is displayed and the two cursors are move to the points to be measured, the ratio to the displayed period is calculated and displayed as a percentage of the displayed period.

Procedure

1. Depress the Δt·1/Δt switch.
2. Depress the RATIO switch. The cursor automatically moves left in interval of the displayed period.
3. Next, move the two cursors to the points to be measured.
4. The ratio to the period displayed in step 2 is calculated and displayed digitally.

Figure 3-13-4. Period ratio measurement



Note: The ratio measurement uses the internal counter. Therefore, "Error" is displayed if the counter is not ready. (V mode and A SOURCE must be set to the same condition and triggered.)

3-13-5 Voltage Difference (ΔV)

The voltage difference between two cursors are measured and displayed. The unit is volts (V).

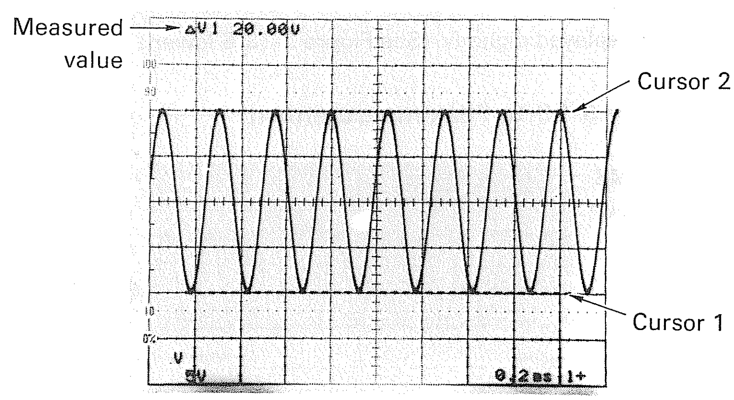
The sign is positive "+" when cursor 1 is below cursor 2 and negative "−" when cursor 1 is above cursor 2.

Procedure

1. Depress the ΔV switch.
2. Enclose the two points to be measured with the two cursors.

   The measured result is displayed digitally. (See Figure 3-13-5.)

Figure 3-13-5. Voltage difference measurement



Note: "ΔV 1" indicates CH 1 and "ΔV 2" indicates CH 2, However, "ΔV 1" is shown for ADD, ALT, CHOP, and QUAD.

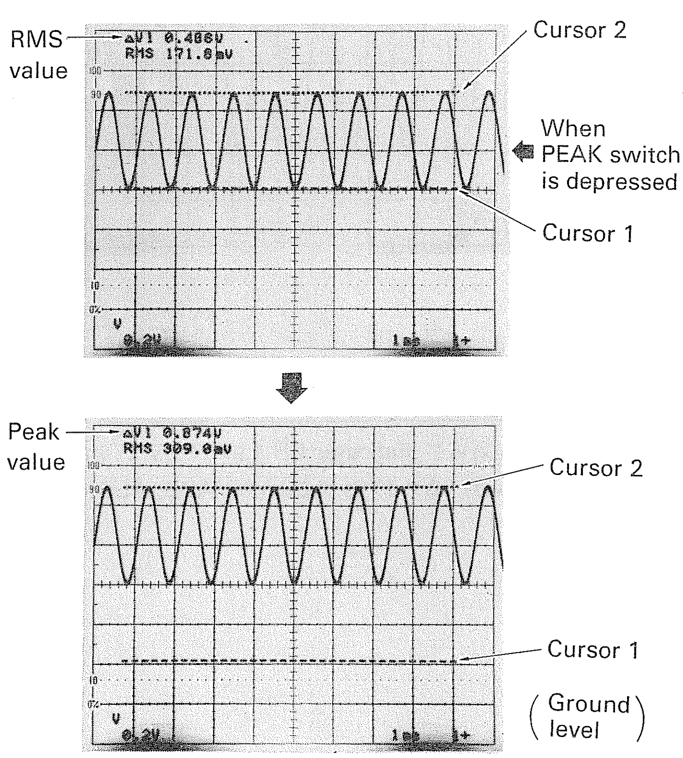
3-13-6 PEAK DETECTOR (PEAK)

The peak of an alternating current (sine wave) within ±3 div from the center of the display is measured. Also, the peak value from ground level (wave height) is measured. The unit is volts (V).

Procedure

1. Depress the ΔV switch.
2. Depress the PEAK switch. (The peak is detected and cursor 2 moves automatically to the peak of the waveform.)
3. Move cursor 1 to the bottom of the waveform. Then the peak value and the RMS (sine wave) are both measured and displayed digitally. (See Figure 3-13-6 upper.)
4. Next, depress the GND switch of CH 1. Then the cursor 1 moves automatically to the ground level, the peak value from the ground level is calculated, and displayed digitally. (See Figure 3-13-6 lower.)

Figure 3-13-6. Peak measurement



Note: PEAK DETECTOR measurement is for CH 1 and A sweep only.

3-13-7 Voltage Ratio (%·dB)

First, set a predefined reference voltage (5 div = 100.0%, 0.0dB) or the interval between two cursors as 100.0%, 0.0 dB. Then, the percentage and decibels of the interval between two cursors are calculated and displayed digitally. (See Figure 3-13-7.)

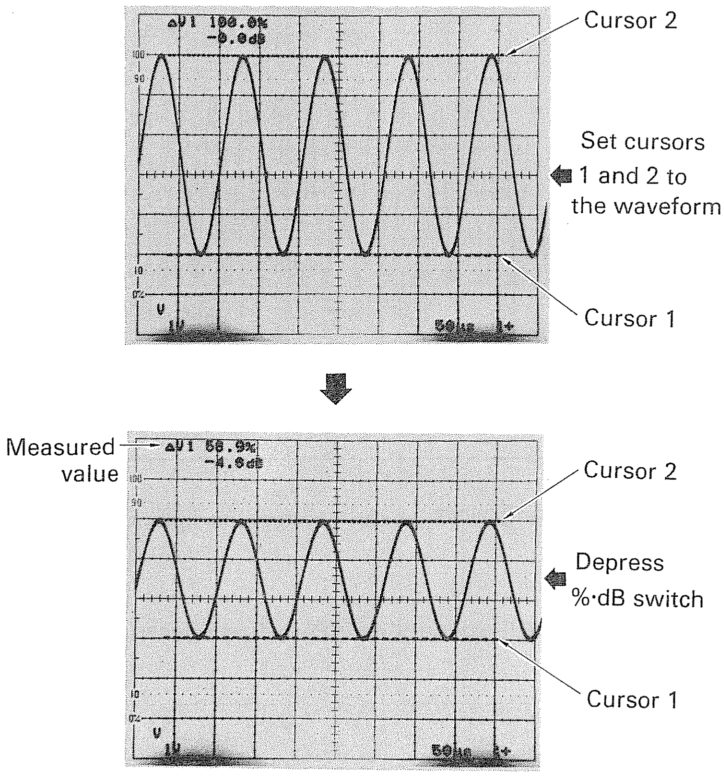
Procedure for measurement from reference voltage

1. Depress the ΔV switch.
2. Set V cursors 1 and 2 to the waveform.
3. Depress the %·dB switch.
4. The measured result is displayed digitally. (See Figure 3-13-7 lower.)

Procedure when an arbitrary interval is defined as 100%

1. Depress the ΔV switch.
2. Depress the %·dB switch.
3. Set V cursors 1 and 2 to two arbitrary points.
4. Depress the REF SET swtich. The interval between the two points set in step 3 becomes the reference value (100%).
5. Enclose the two points to be measured with the cursors. The measured result is displayed digitally.

Figure 3-13-7. Voltage ratio measurement —



Note:

When the %·dB switch is depressed once more, the registered value is canceled and 5 div = 100%, 0.0dB is reset.

3-13-8 Delay Time

The delay time is measured and displayed digitally. The unit is "s". The unit is "DIV" when A VARIABLE is set to UNCAL.

Procedure

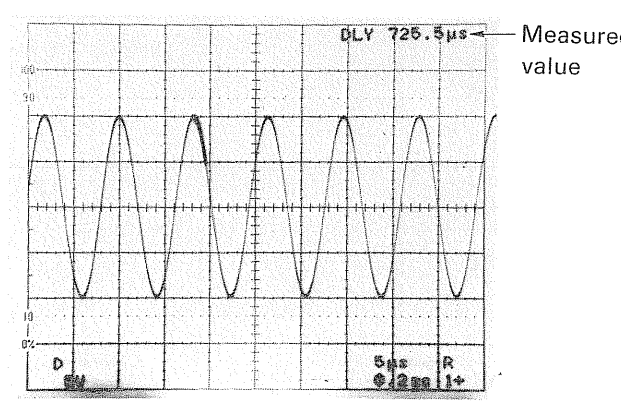
1. Depress the A INTEN, ALT, or B DLY'D switch of the HORIZ DISPLAY.
2. Depress the RUNS AFTER DELAY switch of the B SOURCE.
3. Move the waveform of intensity modulation adjusted waveform with the CURSORS 1 and 2 controls. The delay time can be set faster if CURSORS 1 and 2 controls are depressed while they are turned.
4. The delay time is measured and displayed digitally.

Table 3-13-8 Setting delay time (CURSORS 1 and 2 operation)

Operation and change in delay time	CURSORS 1		CURSORS 2		CURSORS 1		CURSORS 2	
	Turn counterclockwise				Turn clockwise			
	Press	Release	Press	Release	Press	Release	Press	Release
	Decrease delay time (to the left)				Increase delay time (to the right)			
Delay time selection (movement)	Fast	medium	Slow	Very slow	Fast	medium	Slow	Very slow

Note: "Release" in Table 3-13-8 means to turn the control without depressing it.

Figure 3-13-8. Delay time measurement



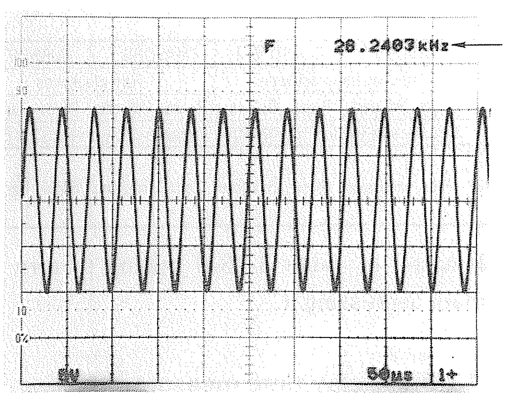
3-13-9 Counter (COUNT)

The internal counter can be used to measure the frequency or period of the input signal (only signal selected by A SOURCE). The units are "Hz" for frequency and "s" for period. The symbols are "F" for frequency and "T" for period.

Procedure

1. Depress the COUNT switch.
2. The frequency of the input signal is measured and displayed digitally. (See Figure 3-13-9 (1).)
3. Depress COUNT switch once again. The period of the input signal is measured and displayed digitally. (See Figure 3-13-9 (2).)

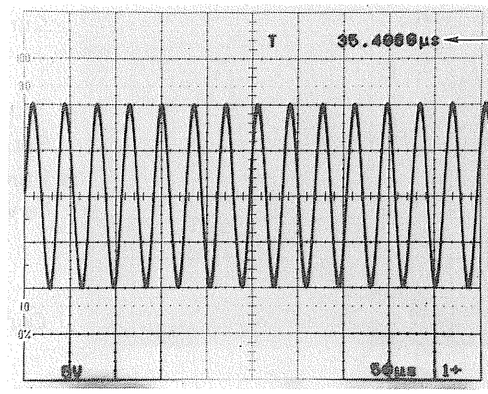
Figure 3-13-9 (1). Frequency measurement using the counter



Measurement value

Depress the COUNT switch

Figure 3-13-9 (2). Period measurement using the counter



Measurement value

Depress the COUNT switch once again

Note: The COUNT switch changes as follows as it is depressed.

→ F (Frequency) → T (Period) → Release

Notes:

- Set A SOURCE the same as vertical MODE and triggered.
- Apply only one signal. Error may occur when more than one signal is applied.
- Set COUPLING to RF REJ when the input signal is less than or equal to 10kHz and LF REJ when it is above 10kHz.
- The following are displayed when there is no input signal or when the input signal is not triggered.

  "F0.00000Hz"
  "Txxxxxxs"
- Extraordinary waveforms such as bursts, and double pulses cannot be measured.
- Set the trigger level to the center of the input signal. Otherwise the count may be in error.

3-13-10 Setting Date and Time (DATE ADJ)

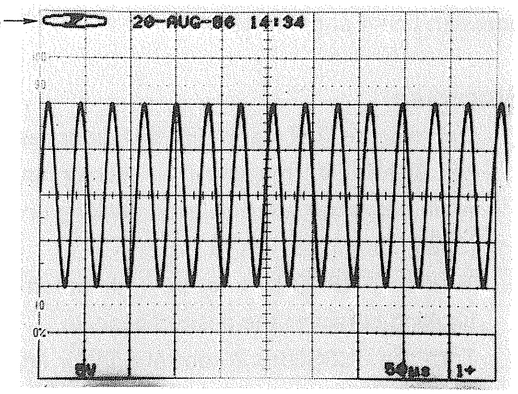
Date and time are entered, changed, and registered with the CURSORS 2 control.

The date and time are displayed as "Date-Month-year Hour: Minute"

1. Depress the DATE switch to display the date and time.
2. Depress the COUNT switch and the DATE switch together to set DATE ADJ mode. The date position on the screen blinks.
3. Turn the CURSORS 2 control to the left or right to set it to the current date.
4. Depress the REF SET switch to register the date. The blinking changes to the month position.
5. Turn the CURSORS 2 control to the left or right to set it to the current month.
6. Depress the REF SET switch to register the month. The blinking changes to the year position.
7. Turn the CURSORS 2 control to the left or right to set it to the current year.
8. Depress the REF SET switch to register the year. The blinking changes to the hour position.
9. Turn the CURSORS 2 control to the left or right to set it to the current hour.
10. Depress the REF SET switch to register the hour. The blinking changes to the minute position.
11. Turn the CURSORS 2 control to the left or right to set it to the current minute.
12. Depress the COUNT and DATE switches together again to cancel DATE ADJ mode. (blinking stops)

Figure 3-13-10. Displaying date and time

Date-Time Display



Note: When setting the date and time with the CURSORS 2 control, the displayed characters move faster when the control is depressed while turning.

3-13-11 Comment Input (COMMENT)

Characters and symbols can be displayed anywhere between line 4 and line 18.

Procedure

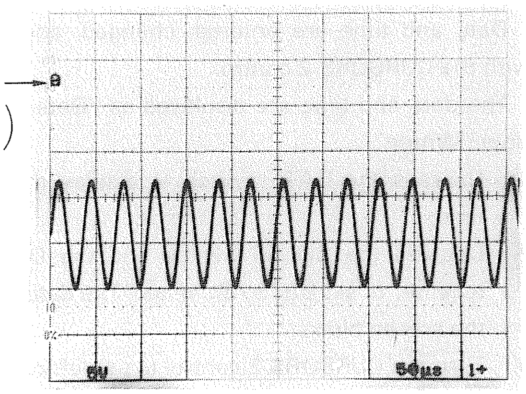
1. Depress the DATA and REF SET switches together to set COMMENT mode. A "–" cursor and a registration character are displayed blinking on the screen. (See Figure 3-13-11 (1))
2. Turn the CURSORS 1 control right or left to move the blinking cursor to the desired position.
3. Turn the CURSORS 2 control right or left to select a character. The character blinks when the control is released.
4. Depress CURSORS 2 control to register the selected character. Then the cursor moves to the next position and blinks.
5. Repeat the above steps to enter characters and register them.
6. To leave the comment on the screen, depress the REF SET switch.
7. To delete a character, turn CHRSORS 1 control to the character to be deleted and then pull the CURSORS 2 control. (See Figure 3-13-11 (2))
8. To delete all comment characters, pull CURSORS 1 and 2 controls together. (The screen returns to initial state) (See Figure 3-13-11 (1))

Notes:

- The cursor moves faster if the CURSORS 1 control is depressed while turning.
- The displayed characters change faster if the CURSORS 2 control is depressed while turning.
- A maximum of 80 characters can be registered.
- To cancel the COMMENT mode, depress the DATA and REF SET switches together when the cursor is blinking.

Figure 3-13-11 (1). Comment mode

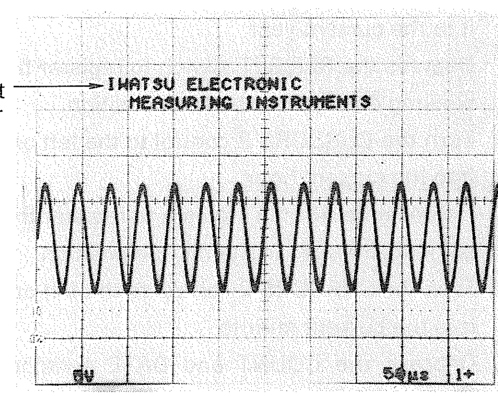
Comment (Blinking)



Initial state

Figure 3-13-11 (2). Comment input

Comment character



Comment registration

3-14 OPERATION FOR DUAL TRACE OBSERVATION

There are two modes of operation, ALT (alternate sweep) and CHOP (chopped sweep), for dual trace observation.

Dual traces of high-to low-frequency signals can be observed by using these ALT and CHOP modes.

In observing dual traces, first press the vertical axis MODE button DUAL, and select ALT or CHOP with the CHOP-ALT switch.

3-14-1 Dual Trace Observation in the ALT Mode

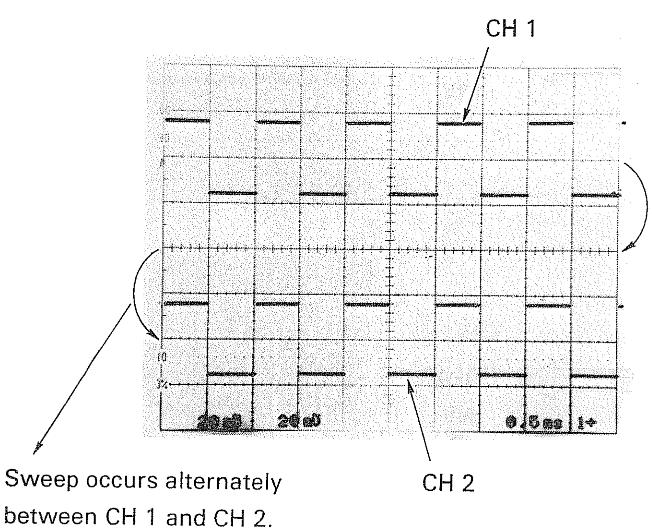
This mode is suitable for observing two signals of high frequency. In the ALT mode, channels 1 and 2 are alternated in sweep so that dual traces can be observed by applying two signals to be observed to the INPUT connectors for channels 1 and 2.

Alternate sweeps are possible in the full range of SEC/DIV, but lowering the sweep rate causes a flickering, which makes dual trace observation difficult. In observing signals that have a low repetition frequency, use the CHOP mode described below.

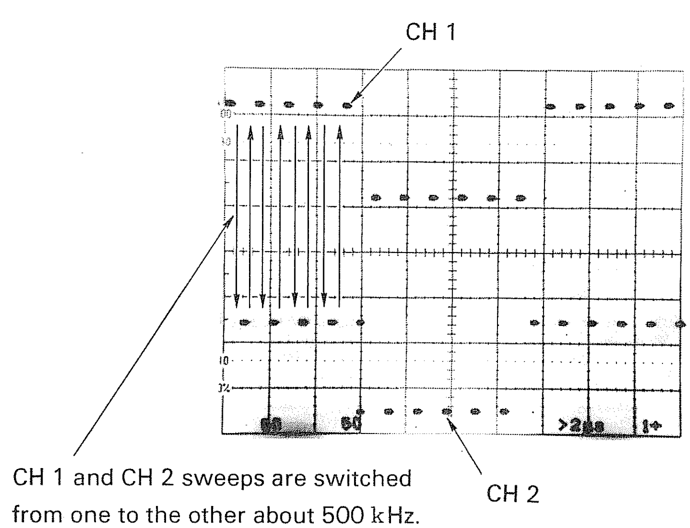
3-14-2 Dual Trace Observation in the CHOP Mode

The CHOP mode is suitable for dual trace observation of low-frequency signals. In this mode, channels 1 and 2 are switched from one to the other at about 500kHz so that, unlike in the ALT mode, it is difficult to observe high-frequency signals because their traces appear like dotted lines.

Figure 3-14. Displayed waveform in ALT and CHOP modes



a. Alternate operation



b. Chopped operation

3-15 OPERATION FOR OBSERVING THE SUM OR DIFFERENCE OF TWO SIGNALS

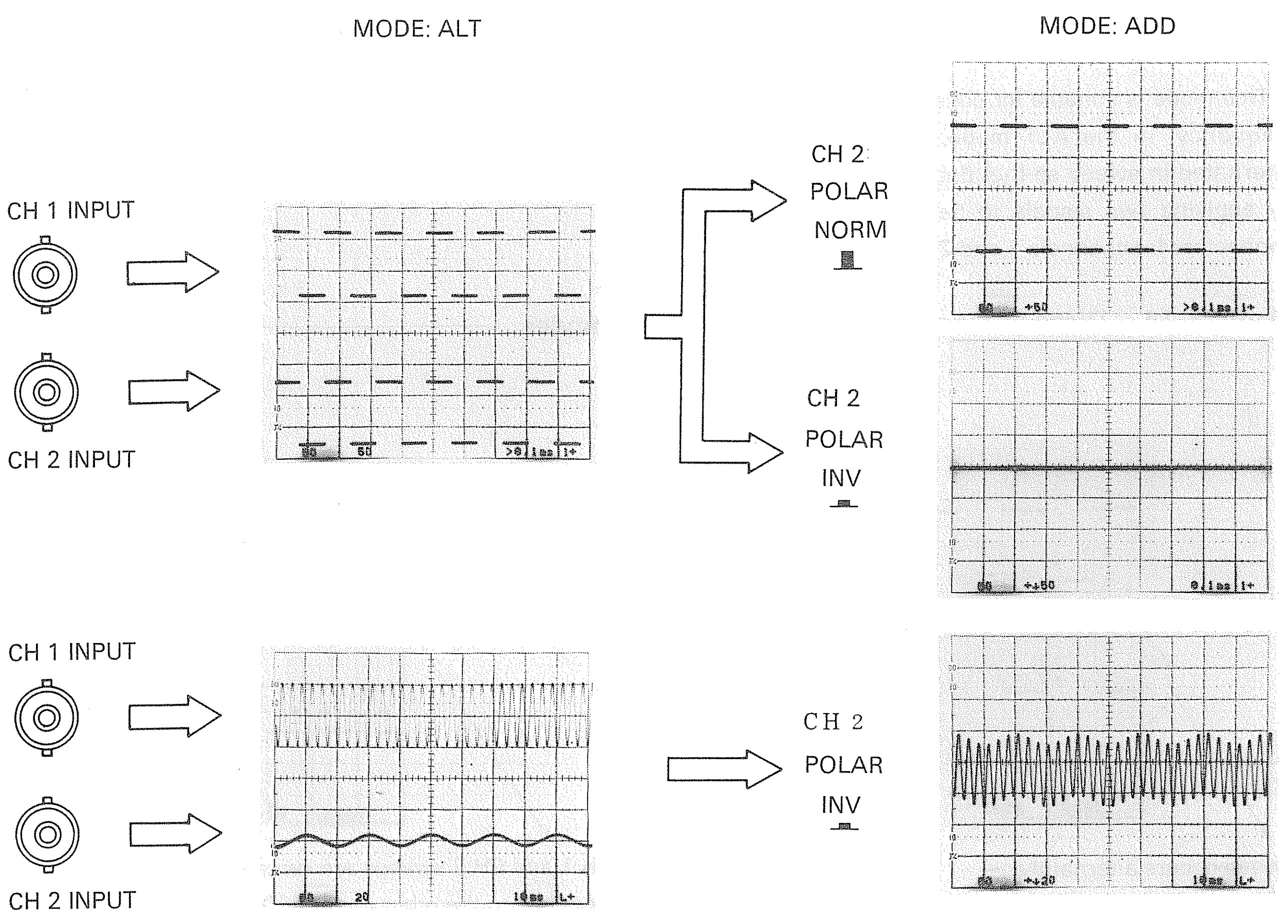
Observation in the ADD mode

The ADD mode is selected when both vertical MODE switches CH1 and CH2 are simultaneously pressed. When signals are applied to the INPUT connectors for channels 1 and 2 in this mode, the sum of the two signals (on channels 1 and 2) can be observed. When the CH 2 POSITION switch is pulled to the INV position, the difference between the two signals (channel 1 minus channel 2) can be observed.

In using the ADD mode, the deflection factors for the individual channels must be adjusted to suit the purpose.

The POSITION controls for both channels may be used for adjusting trace positions in the ADD mod. These switches, however, should be kept nearly at the center position for correct measurement.

Figure 3-15. ADD operation



3-16 OPERATION FOR QUADRUPLE TRACE OBSERVATION

The SS-6122 can simultaneously display up to four signals on the CRT screen aside form the dual-trace capability.

If the vertical MODE buttons ALT and QUAD, or CHOP and QUAD are simultaneously pushed IN, traces for CH 1, CH 2, CH 3, and CH 4 are displayed on the CRT screen. Thus, by applying the four signals to be measured to the respective input connectors, the four signals can be simultaneously observed.

If the HORIZ DISPLAY mode ALT is selected under this condition, 8 traces are displayed on the screen as shown in Figure 3-16-2, giving A INTEN AND B sweeps for the respective channels.

The vertical axis of quadruple traces is displayed by chopped operation if the vertical MODE buttons CHOP and QUAD are pushed IN, or by alternate operation if the vertical MODE buttons ALT and QUAD are pushed in. When observing signal faster than 1 msec/div, push the vertical MODE buttons CHOP and QUAD IN. When observing signal slower than 1 msec/div, push the vertical MODE buttons ALT and QUAD IN.

Figure 3-16-1. Quadruple-trace observation ——

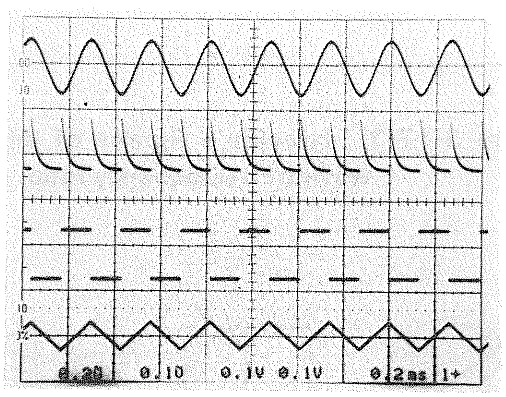
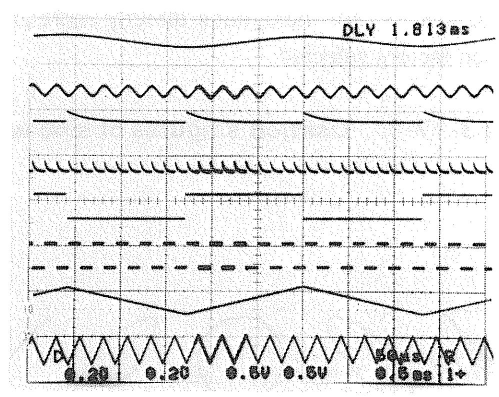


Figure 3-16-2. Quadruple-trace observation in the ALT mode.



3-17 OPERATION AS X-Y SCOPE

The SS-6122 operates as an X-Y scope if the HORIZ DISPLAY is set to X-Y.

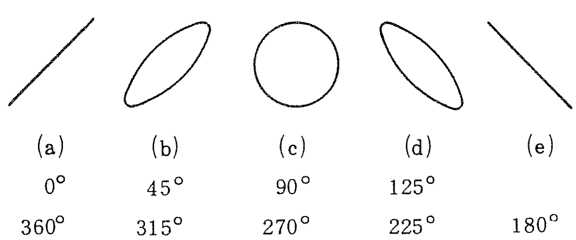
When signals are applied to the INPUT connectors for channels 1 and 2, the signal on channel 1 drives the horizontal axis (X) and the signal on channel 2 dirves the vertical axis (Y) to display a Lissajou's figure.

By operating the SS-6122 as an X-Y scope, phase differences, Lissajou's figures of various frequency ratios, and hysteresis curves can be observed.

In using it as an X-Y scope, move the waveforms using the CH 2 vertical POSITION, horizontal POSITION and FINE controls.

The deflection factor for the X axis can be adjusted with CH 1 VOLTS/DIV and VARIABLE, and deflection factor for the Y axis with CH 2 VOLTS/DIV and VARIABLE. When VARIABLE is turned to the CAL position, VOLTS/DIV indications directly represents the deflection factors selected.

Figure 3-17-1. Lissajou's figures of sine waves



Figures 3-17-1 and 3-17-2 show Lissajou's figures of sine waves of different frequencies. As shown, various figures are described depeding on the phase difference and frequency ratio. All of them are to be observed still.

Figure 3-17-3 shows examples of Lissajou's figures of different waveform.

Figure 3-17-2. Lissajou's figures of various frequency ratios

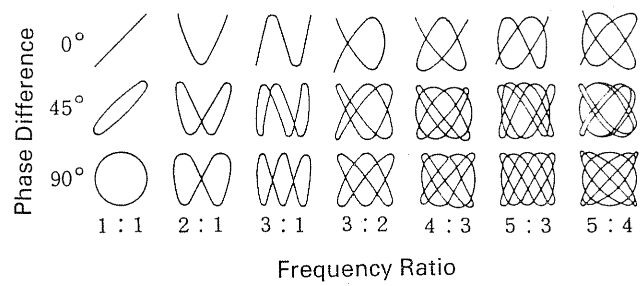
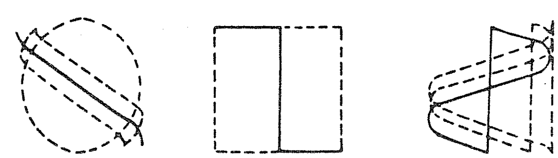


Figure 3-17-3. Lissajou's figures of different waveform (Frequency ratio: 1 to 1)



(a) Sine wave and triangle wave (b) Sine wave and square wave (c) Sine wave and sawtooth wave

3-18 OPERATION FOR SINGLE SWEEP OBSERVATION

Discharge waveforms and other high-speed transient phenomena, such as of relay chattering, are displayed in multiple overlapped waveforms in the normal high-speed repeating sweep mode. If the sweep rate is lowered to display an entire waveform, transient phenomena cannot be observed in detail. If the single sweep function is used, however, transient phenomena can be obsered fully magnified in the horizontal axis direction, or recorded by photographing them. (See Figure 3-18.)

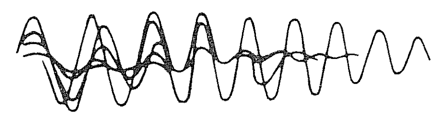
The basic single sweep operation procedure using a calibrated voltage as an input signals is described below.

1. Select the HORIZ DISPLAY mode A and horizontal MODE NORM.
2. Apply a calibrated voltage of 0.6 V to INPUT, using the supplied probe. Set VOLTS/DIV to 10 mV, and confirm proper triggering.
3. Select the horizontal MODE SINGLE, and press SINGLE/RESET so that a single sweep occurs.
4. Disconnect the input signal, and press SINGLE/ RESET. Check the LED of READY that it lights.

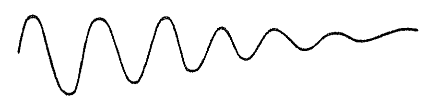
If the LED of READY lights, the device is in ready state for sweep. It performs a single sweep upon receiving a trigger signal. (The device may not be in ready state at a point near the cente of LEVEL. In that case, slightly turn LEVEL clockwise or counterclockwise.) When a signal is input to the device in this state, a single sweep takes place to properly display a waveform.

This single sweep operation is also possible in the A INTEN sweep and B (DLY'D) sweep modes. It is also possible in the external trigger mode if an external trigger signal is used in the same way as an input signal in the internal trigger mode. A simultaneous single sweep of two waveforms can be made only in the CHOP mode, not in the ALT mode.

Figure 3-18. Example of repetition sweep and signal sweep waveform



Repeated Sweep



Single Sweep

3-19 OBERATION FOR TELEVISION SIGNAL OBSERVATION

The SS-6122 has a television synchronizing separator circuit so that television and other composite video signal waveforms can be displayed. The operation procedure is as follows.

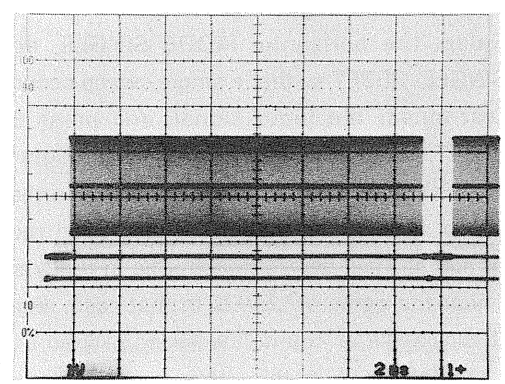
3-19-1 Ovservation by Normal Sweep

1. Set the controls as follows:

HORIZ DISPLAY	A
A SEC/DIV	2ms/div(when observing a V signal) or 10μs/div(when observing a H signal)
Vertical MODE	CH 1 or CH 2(whichever a signal is applied to)
COUPLING	TV-V(when observing a V signal) or TV-V(when observing a H signal)
SCOURCE (internal trigger)	CH 1 or CH 2 (whichever a signal is applied to) or NORM
(external trigger)	CH 3(Apply a signal to CH 3 INPUT.)

2. Apply the composite signal to be measured to CH 1, CH 2, or CH 3.
3. Adjust so that the composite video signal waveform has an ampitude of 2 division or more (30% of the synchronizing signal component) on the screen.
4. Selects the horizontal mode AUTO or NORM.
5. Turns the SLOPE control to the + position if the synchronizing signal component of the composite video signal measured is positive-going; or to the +position if it is negative-going.
6. Turn the SEC/DIV switch to display the desired part of the signal on the screen.

Figure 3-19-1. Example of observation V synchronizing signal and video signal

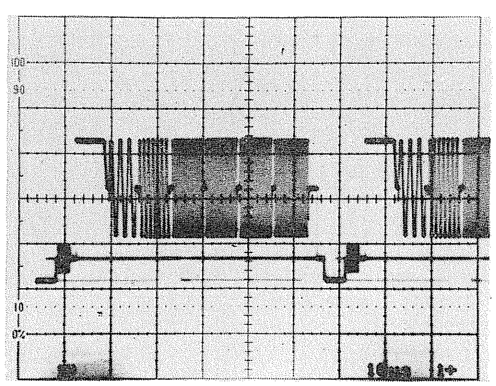


3-19-2 Magnified Observation by Delayed Sweep

1. In continuation of the above steps, set the HORIZ DISPLAY switch to A INTEN.
2. Turn A SEC/DIV switch to 2 msec/div.
3. When observing by continuous delay, set the B-sweep SOURCE button to RUNS AFTER DELAY; or when trigger delay is desired, set it to CH 1 or CH 2 or CH 4. (Apply the synchronizing signal to CH 4 INPUT if CH 4 is selected.)
4. Select the desired part to be magnified, using DELAY TIME.
5. Set the HORIZ DISPLAY switch to B (DLY'D), and select the desired magnification ratio with B SEC/ DIV switch.
6. The SS-6122 has no 1st-2nd field switching function, but it can be accomplished with an accuracy of about 50% by shifting the AC-DC button or by pushing or pulling the SLOPE control.

Figure 3-19-2. Example of observation of H synchronizing signal and video signal

Video signal



H synchronizing signal

3-20 OPERATION FOR WAVEFORM MAGNIFICATION

Part of the waveform displayed on the CRT screen can be magnified timewise(in the horizontal axis direction) for detailed observation in the following three ways.

- Raising the sweep rate.
- Magnifying by use of the MAG x10 function.
- Magnifying by use of the delayed sweep function. Each of there is described in detail below.

3-20-1 Raising the Sweep Rate

Select a high sweep rate for magnified observation of the tip of the waveform. Remember, however, that a high sweep rate moves the center and end of the waveform out of the CRT screen so they cannot be observed. In such a case, use the x10 MAG function described below.

3-20-2 Waveform Magnification by the x10 Function

The MAG function is mainly used for magnifying the center or end part of the waveform displayed on the CRT screen.

As described in 3-12, move the desired part of the waveform to be magnified to the center of the screen with ←→ POSITION, and pull FINE (PULL x10 MAG) so that the desired part of the waveform is magnified ten times from the center of the CRT screen to the right and left. The trace length at this time is about ten divisions on the CRT screen, but is actually about 100 divisions. The trace can be observed full length by use of ←→ POSITION and FINE.

This method is simple, but the magnification ratio is limited to 1 to 10. The sweep rate for a magnified waveform is the value indicated by SEC/DIV multiplied by 1/10. The maximum sweep rate for magnified observation is 10 ns/division x1/10 = 1 ns/division, as compared with the maximum sweep rate for non-magnified observation which is 10 ns/division.

3-20-3 Waveform Magnification by the Delayed Sweep Function

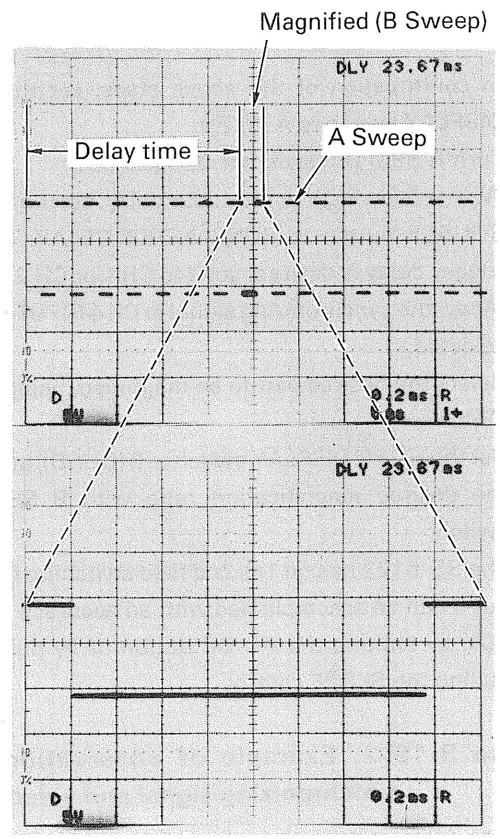
The above magnification method has the advantages of simple operation and raising the sweep rate by ten times the value indicated by SEC/DIV, but the magnification ratio is limited to 1 to 10.

The delayed sweep function permits magnification of any part of the waveform displayed on the CRT screen by a value dependent on the A-sweep to B-sweep ratio:

$$\frac{\text{A SEC/DIV(sec/div)}}{\text{B SEC/DIV(sec/div)}}$$

This magnification method, however, is subject to Imitation depending on the input signal frequency. In other words, if an input signal has a high frequency and if A SEC/DIV is at the highest rate position before magnifying the waveform, it cannot be magnified any more. Therefore, the delayed sweep magnification method is suitable to magnifying input signals of relatively low frequency for observing any desired parts of them.

Figure 3-20. Magnification by continous delay



Delayed sweep magnification comes in continuous delay and trigger delay as described below.

Continuous Delay: Operation for continuous delay is as follows:

1. Select the HORIZ DISPLAY mode A, apply an input signal, and triggering.
2. Turn the B SEC/DIV switch to a position faster than the A SEC/DIV switch.
3. Select the B-sweep SOURCE mode RUNS AFTER DELAY.
4. Select the HORIZ DISPLAY mode A INTEN

If the DLY controles turned clockwise after taking the above steps, a particularly intensity moduration part appears as shown in the upper waveform of Figure 3-20, and moves continuously from left to right. If this intensity moduration part is moved to a position where is measured, and if the HORIZ DISPLAY mode B (DLY'D) is selected, that part can be magnified fully on the CRT screen as shown in the lower waveform of Figure 3-20.

Use the B SEC/DIV switch for selecting a B (DLY'D) sweep rate. The magnification ratio increases as the sweep rate is increased. If the magnification ratio is raised so much delay jitter showns, making waveform observation difficult. Thus, there are limitations on magnified waveform observation by countinuous delay due to delay jitter. In such a case, use the trigger delay described below if a higher magnification ratio is desired.

The delay time of the magnified part can be calculated by multiplying the indicated value of A SEC/DIV switch by the indicated value of the DLY control.

Trigger Delay: Trigger delay can be selected if the B-sweep SOURCE switch is set to CH 1, CH 2, or CH 4 (if a trigger singal is applied to CH 4). Delayed magnification can be made by B-sweep triggering and performing the same steps of operation as those of continuous delay.

The magnified part (B-sweep) in trigger delay starts at a trigger point subsequent to the dealy time selected with the DLY control. The trigger point moves as DLY control is turned.

If DLY control is turned during a B (DLY'D) sweep, the waveform may appear still, but actually you are watching the part selected in the A INTEN sweep mode.

B-Sweep Trigger

The B-sweep tirgger controls include B-sweep COUPLING, SOURCE, and LEVEL.

The LEVEL and COUPLING (except for LF REJ, TV-H, TV-V) functions and operations are the same as the A-sweep LEVEL and COUPLING functions and operations. The SOURCE button is used for selecting a trigger signal. RUNS AFTER DELAY is for continuous delay; and CH 1, CH 2 and CH 4(external trigger function of the conventional oscilloscope) are for trigger delay. If CH 4 is selected, apply a trigger signal to CH 4 INPUT. If CH 1, CH 2 is selected, the same function as in the A-sweep mode is performed.

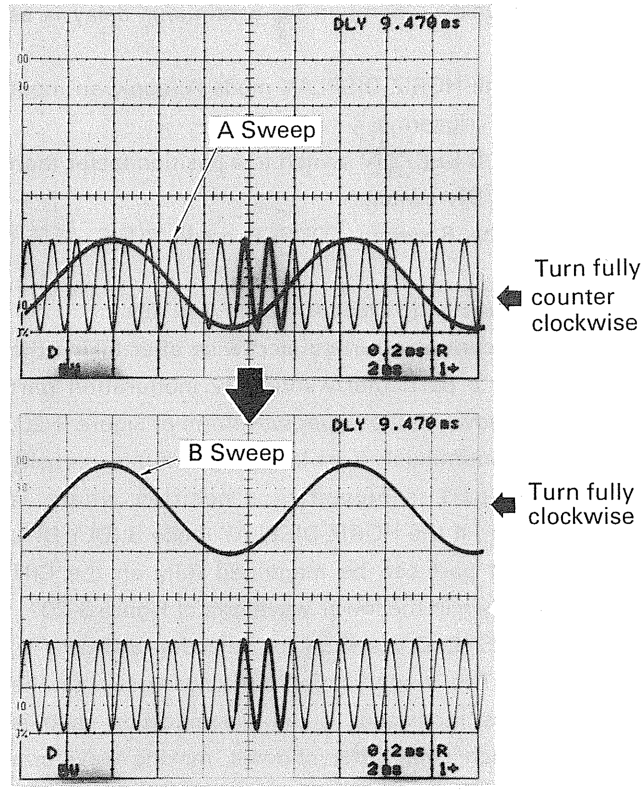
3-21 OPERATION FOR ALT SWEEP

The ALT sweep function is used for alternate a INTEN sweep and delayed B sweep. This allows simultaneous observation of the non-magnified part and magnified part of the waveform. The operation procedure is as follows:

1. Select the HORIZ DISPLAY mode A, input the signal to be measured, and triggered it.
2. Select a magnification ratio by the ratio of B SEC/DIV to A SEC/DIV.
3. Set the RUNS AFTER DELAY button to the RUNS AFTER DELAY position.
4. Set the HORIZ DISPLAY mode ALT.
5. Move the B sweep to the desired part of the A sweep to be magnified, using DLY control. Adjust the B sweep waveform (magnified waveform) to a position where it it easy to observe as shown in Figure 3-21, using TRACE SEPARATION.

Note: When TRACE SEPARATION is fully turned counter-clockwise, the A sweep waveform and B sweep waveform (magnified waveform) completely register. When TRACE SEPARATION is fully turned clockwise, the B sweep waveform is about four divisions or more above the A sweep waveform.
Jitters occur as the magnfication ratio is raised by changing the ratio of A SEC/DIV to B SEC/DIV. If jitters occur, push the CH 1. CH 2 or CH 4 switch into the IN position.

Figure 3-21. Operation of ALT sweep and TRACE SEPARATION



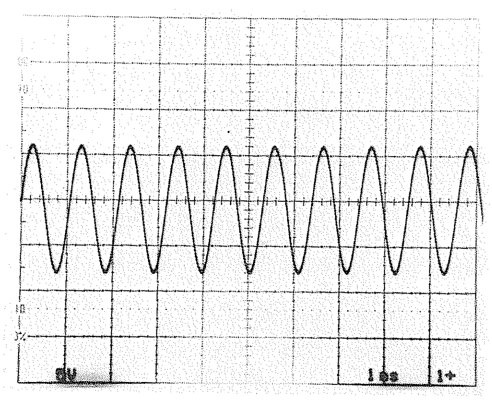
3-22 EXTERNAL INTENSITY MODULATION

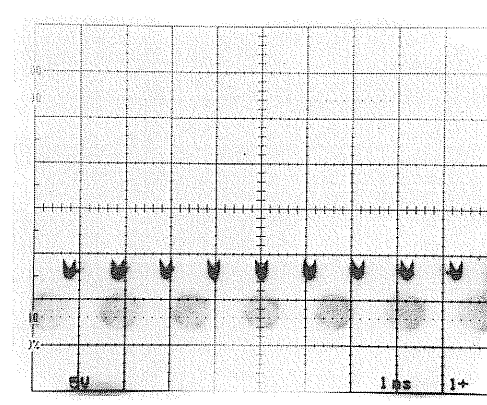
In addition to the vertical (Y) axis and horizontal (X) axis, the Z axis is used for displaying signals to be measured. The SS-6122 is so designed that the intensity of the waveform displayed on the CRT screen can be changed by applying an input signal from Z AXIS INPUT on the rear panel to the CRT circuit. Intensity modulation of an intermediate level can be obtained by applying a signal not high enough to completely erase the displayed waveform.

A negative signal increases the intensity, and a positive signal decreases it. An input voltage of 0.5 Vp-p produces a signal amplitude at which intensity modulation can be observed, provided that the intensity setting is correct. The effect input frequency range is from DC to 5 MHz, and the maximum input voltage is ±50 V Max.

A time reference for displayed waveforms can be obtained by applying a time marker to Z AXIS INPUT. The time relationships of displayed waveforms observed at a noncalibrated sweep rate can be measured using this time marker.

Figure 3-22. Example of intensity modulation display





External intensity modulation

Section 4

Measuring Instructions

4-1 ADJUSTMENTS NECESSARY BEFORE MEASUREMENT

It may be necessary to adjust the adjusters on the front panel and bottom before attempting measurements in order to assure accuracy of measurements. In case of measuring with a probe, its phase adjustment is necessary. Whichever the case, the adjusting screwdirver (supplied as an accessry to the probes) may be used for adjustment purposes.

To keep constant the internal temperature of this instrument oscilloscope, the eight holes for adjustment in the bottom cover are covered with lids. When adjusting the oscilloscope, remove those lids with tweezers. After completion of the adjustment, be sure to mount the lids in place.

About 30 minutes of warmup is recommended for stabilizing operation befor adjusting the controls and probe phase.

4-1-1 TRACE ROTATION Adjustment

Traces may become not parallel to the graticule lines on the CRT screen due to geomagnetic effect or other cause.

If that occurs, display a trace on the CRT screen, move it to the center of the screen with ↕ POSITION, and adjust the trace parallel to the graticule lines with TRACE ROTATION. Before making this adjustment, install the SS-6122 in the normal place of use for measurements.

4-1-2 GAIN Adjustment (Common to CH 1 and CH 2)

Vertical deflection check and adjustment are necessary to assure accuracy of voltage measurements.

The check and adjustment method is as follows. Set VOLTS/DIV switch to 10 mV, and connect INPUT to the CAL 0.6 V output teminal with an accessory probe. Check that the amplitude of the waveform displayed on the CRT screen is 6 divisions. If it is not rating adjust it with the GAIN. (See Figure 4-1.)

4-1-3 x5 BAL (Common to CH 1 and CH 2)

When the change in surrounding temperature is large, the vertical trace position may move when the VARIABLE is pushed and pulled.

In such case, use "x5 BAL" control to adjust the vertical trace position while pushing and pulling the VARIABLE control. (See Figure 4-1.)

4-1-4 VARIABLE BAL Adjustment (Common to CH 1 and CH 2)

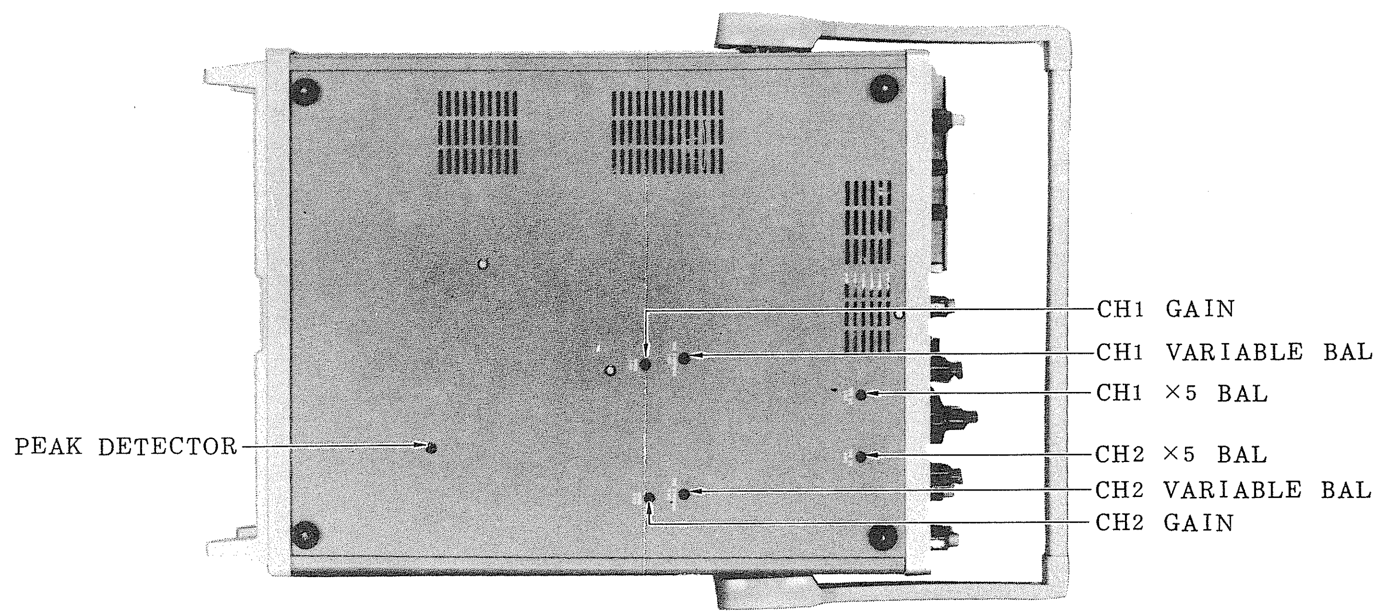
When the change in surrounding temperature is large the vertical trace position may move when the vertical deflection system VARIABLE control is turned.

In such case, use "VARIABLE BAL" control to adjust the vertical trace position while turning the VARIABLE control. (See Figure 4-1)

4-1-5 PEAK DETECTOR (Common to CH 1 and CH 2)

Adjust with "PEAK DETECTOR" when the trace doese not match the cursor position during peak detection (input GND).

Figure 4-1. Adjusters on botton cover



4-1-6 Probe Phase Adjustment

10:1 passive probe phase adjustment

A mismatched probe phase can result in measuring the wrong waveform. Be sure to correctly adjust the probe before use.

First, set VOLTS/DIV to 10mV, connect the probe to INPUT and the CAL 0.6 V output terminal so that a calibration voltage waveform with an amplitude of 6 divisions is displayed on the CRT screen.

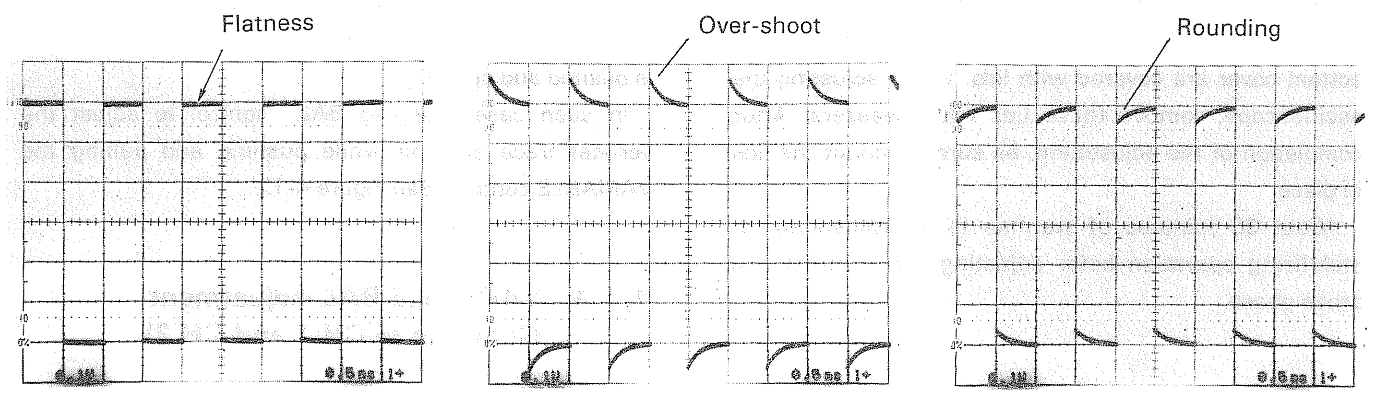
Next turn the variable capacitor of the probe. The waveform changes as shown in Figure 4-1-6 b or c. Adjust the variable capacitor correctly unitl the waveform is asshown in Figure 4-1-6 a.

Current probe sensitivity check

When using a current probe for measurement, check its sensitivity beforehand.

Read the instruction manual for the current probe for the checking procedure. The SS-6122 has the CAL 10 mA current loop terminal on the rear panel, where a square wave current of 10 mA flows in the arrow direction.

Figure 4-1-6. 10:1 passive probe phase waveforms



a. Correct compensation   b. Excessive compensation   c. Insufficent compensation

4-2 VOLTAGE MEASUREMENT

4-2-1 Quantitative Measurement

The quantitative measurement of voltage can be made by setting the VOLT/DIV VARIABLE control to the CAL position. The measured value can be calculated by Equation 4-2-1-(1) or 4-2-1-(2).

a. Measurement with the measuring cable;
   Voltage(V) = VOLTS/DIV setting value(V/div) × Displayed amplitude of input signal (div) .... 4-2-1-(1)

b. Measurement with the 10:1 probe;
   Voltage(V) =VOLTS/DIV setting value(V/div) × Displayed amplitude of input signal(div) × 10 .... 4-2-1-(2)

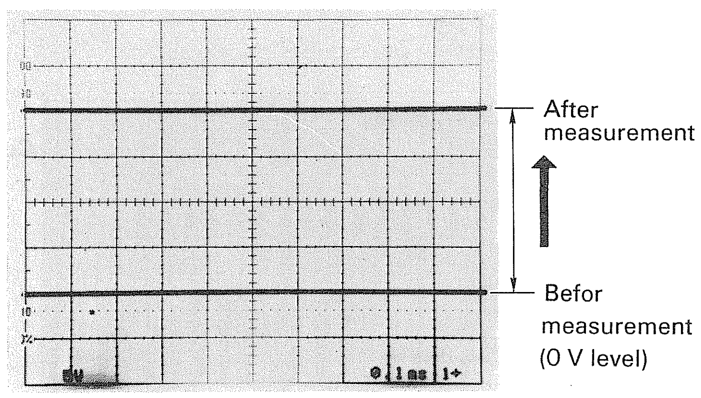
4-2-2 DC Voltage Measurement

Instrument functions as a high input resistance, high sensitivity, quick response DC voltmeter in order to measure DC voltage. Measurement procedure is as follows:

<Measurements without using the cursor>

1. Set the sweep MODE switch to AUTO and set the A, B SEC/DIV switch to 0.1 ms position.
2. Set the GND switch to GND. The vertical position of the trace in this case is used as 0-volt reference line as shown in Figure 4-2-2-(1). Adjust the vertical POSITION control in order to place the trace exactly on a horizontal graticule, which facilitates the reading of signal voltage.
3. Set the AC-DC switch to DC, and apply the voltage to be measured to the input connector. The vertical displacement of the trace gives the voltage amplitude of the signal. When the trace shifts upward, the measured voltage is positive with regard to the ground potential. When the trace shifts downward, the voltage is negative. The voltage can be obtained by Equation 4-2-1-(1) or 4-2-1-(2).

Figure 4-2-2-(1). DC voltage measurement (Without using the cursor)



VOLTS/DIV setting valve: 5V/div
Displayed amplitude of input signal: 4div
Voltage = 5V/div × 4div = 20V

SS-6122 Section 4 Measuring Instructions

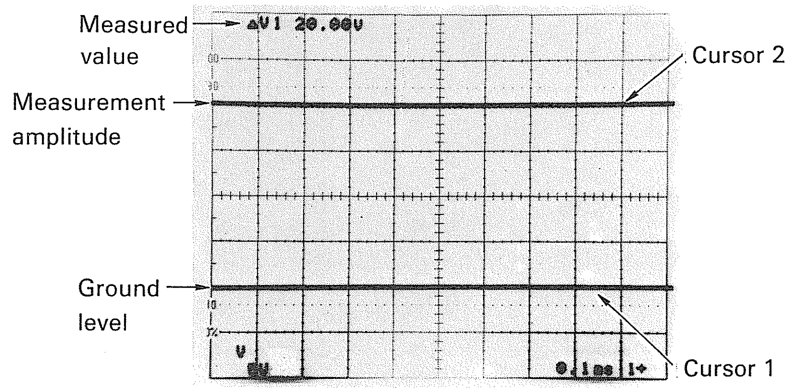
<Measurements using the cursor>

1. Set the sweep mode to AUTO and set the A, B SEC/DIV swich to 0.1 ms position.
2. Set the input coupling AC - DC to DC.
3. Set the cursor measurement mode ΔV switch to "IN."
4. Turn CURSORS 1 control to move cursor 1 to the trace line, (ground level).
5. Connect the probe or measurement cable to INPUT and touch the other end to the point to be measured. At the same time, turn CURSORS 2 control to move cursor 2 to the trace line. (See Figure 4-2-2-(2).)
6. The result is displayed as "ΔV1" on the screen in digital form.

Cautions

- With cursor measurement, the result is displayed as actual value in digital form regardless of weather the attached probe is used or a measurement cable is used.
- In step 5 above,if the trace line moves below the ground level (cursor 1 position), the result is displayed as a negative ("–") value when cursor 2 is moved to that position.

Figure 4-2-2-(2). DC voltage measurement (Using the cursors)

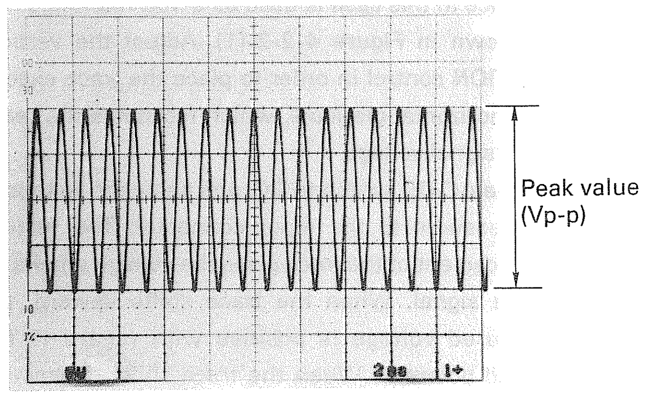


4-2-3 AC Voltage Measurement

<Measurements without using the cursor>

The measurement of the voltage waveform is perormed as follows; Set the VOLTS/DIV switch in order to obtain the amplitude for easy reading, read the amplitude as shown in Figure 4-2-3-(1) and calculate by Equation 4-2-1-(1) or 4-2-1-(2).

Figire 4-2-3-(1). AC voltage measurement (without using the cursor)



VOLTS/DIV setting valve: 5V/div
Displayed amplitude of input signal: 4div
Voltage = 5V/div × 4div = 20V

When the waveform superimposed on DC current is measured, set the AC-DC switch to DC in order to measure the value including DC component, or set this switch to AC in order to measure AC component only.

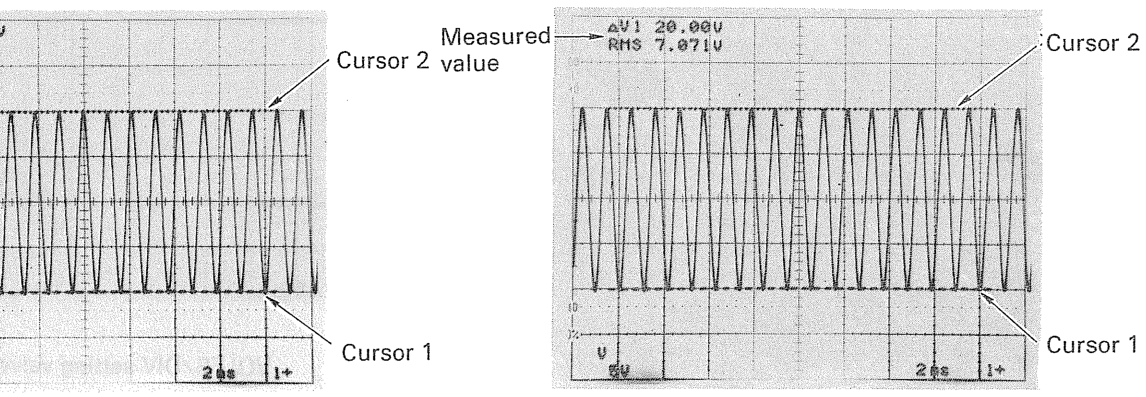
The measured value by means of this prcedure is peak value (Vp-p). Effective value (Vrms) of a sine wave signal can ba given by Equation 4-2-3.

$$\text{Effective voltage(V rms)} = \frac{\text{peak voltage(V p-p)}}{2\sqrt{2}} \quad \cdots\cdots\cdots \text{4-2-3}$$

<Measurements using the cursor>

1. Press the cursor measurement mode ΔV switch.
2. Turn CURSORS 1 and CURSORS 2 controls so that cursor 1 is at the bottom of the amplitude and cursor 2 is at the top of the amplitude. (See Figure 4-2-3-(2).)
3. The result is displayed as "ΔV1" on the screen in digital form. (See voltage difference ΔV in section 3-13-5.)
4. The effective value in the above equation is displayed as shown in Figure 4-2-3-(2) by pressing the PEAK switch. (See section 3-13-6.)

Figire 4-2-3-(2). AC voltage measurement (Using the cursors)



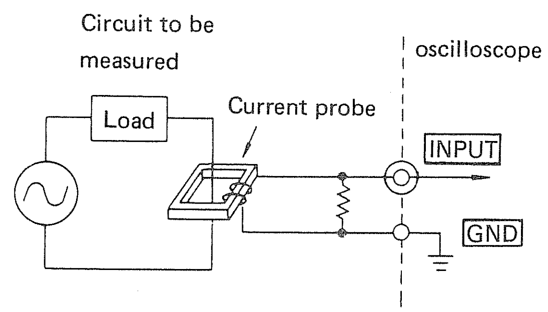
4-3 CURRENT MEASUREMENT

Phenomena that can be observed by direct input application to the oscilloscope are voltage phenomena. All electrical phenomena other than voltage phenomena, such as mechanical vibrations and all others, require conversion into voltages for applying to INPUT.

In current measurements, a resistor of a known value is added to the circuit to be measured, and voltage variations at both ends of the resistor are observed on the CRT screen of the oscilloscope. The current value is caluculated from the relationship V = IR. The resistor to be added to the circuit must have a resistance within a range in which the circuit will not change in operating condition. In case a resistor cannot be added to the circuit to be measured for reasons of operation, a current probe may be used for measuring currents without disconnecting the circuit. As shown in Figure 4-3 the current at the measuring point is detected by the core and secondary winding, and is applied to the vertical deflection system of the oscilloscope.

When measuring a small current, the output of the secondary winding is amplified and then applied. When measuring a large current, a shunt is inserted to apply a divided current. Otherwise, the core will be saturated. This method, however, is subject to limitation in frequency bandwidth. That is, it is unusable for high-frequency signals. If the circuit is ungrounded, a signal input cannot assure accurate current measurement. That is, a differential input amplifier is necessary in that case. As mentioned in the paragraph on Operation for observation of the Sum of Two Signals or their Difference, the SS-6122 can be used for differencial observation. This capability may be used in the following way. Select the vertical mode ADD, and CH 2 POLAR INV. Connect a probe to CH 1 and CH 2 INPUTs, and its tips to both ends of the resistor inserted. Turn the VOLTS/DIV switches for CH 1 and CH 2 to the same position. The wave forms for both ends of the resistor,i,e., current waveforms, can now be observed.

Figure 4-3. Current waveform measurement with current probe



4-4 TIME MEASUREMENT

<Measurements without using the cursor>

The time interval of two points on a signal waveform can be calculated as follows: Set the SEC/DIV VARIABLE control to CAL. Read the setting values of the SEC/DIV and x10 MAG switches and calculate the time by Equation 4-4.

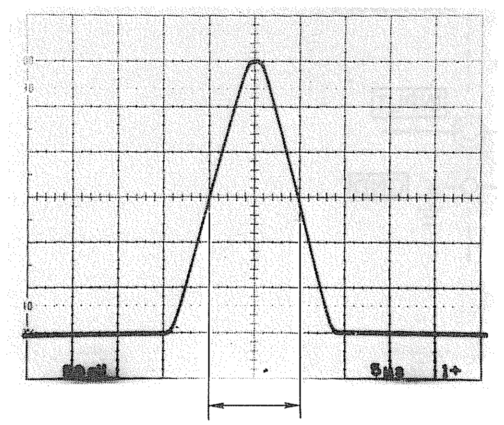
Time(s) = SEC/DIV setting value (s/div)
× Length corresponding to the time to be measured (div)
× Reciprocal number of × 10 MAG setting value 4-4

Where, the reciprocal number of the ×10 MAG setting value is 1 when the sweep is not magnified, and 1/10 when the sweep is magified.

<Measurements using the cursor>

1. Press the cursor measurement mode Δt·1/Δt switch.
2. Set cursors 1 and 2 to any position on the waveform and measure. (See time difference Δt in section 3-13-2.)

Figure 4-4-1-(1). Pulsewidth measurement (Without using the cursor)



4-4-1 Pulse-width Measurement

The basic pulsewidth measurement procedure is as follows:

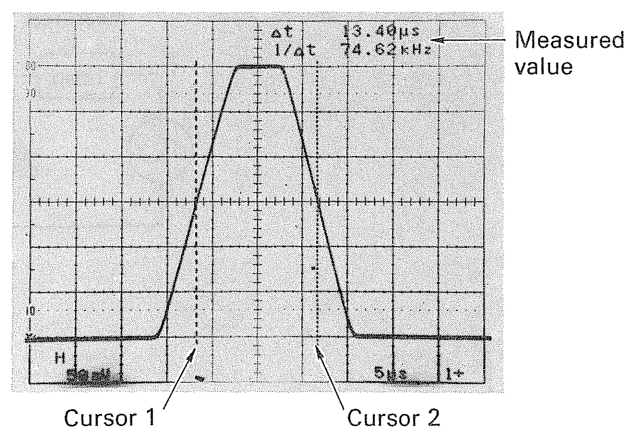
<Measurements without using the cursor>

1. Display the pulse waveform vertically so that the distance between the top part of the pulse waveform and the horizontal center line of the graticule may be equal to the distance between the bottom part of the pulse and the horizontal center line as shown in Figure 4-4-1-(1).
2. Set SEC/DIV switch in order to make the easy observation of the signal.
3. Read the distance between centers of rising and falling edges,i.e., the distance between two points at which pulse edges cross the horizontal center line of the graticule. Calculate the pulsewidth by Equation 4-4.

<Measurements using the cursor>

1. Press the cursor measorement mode Δt · 1/Δt switch.
2. Measure the value in the same manner as item 3 above by adjusting cursors 1 and 2 to the respective points where the waveform intersects the horizontal center line. (See Figure 4-4-1-(2).)

Figure 4-4-1-(2). Pulsewidth measurement (Using the cursors)



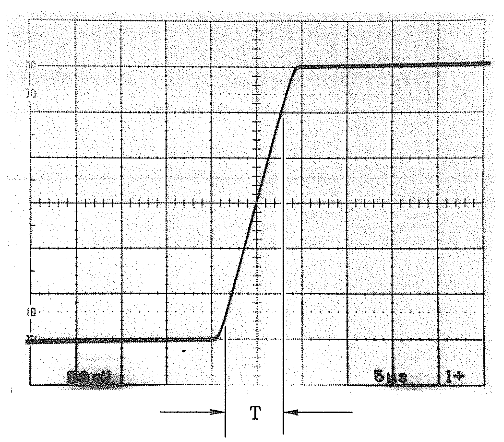
4-4-2 Rise (or Fall) Time Measurement

The rise (or fall) time measurement of the pulses is obtained as follows.

<Measurements without using the cursor>

1. Display the pulse waveform vertically and horizontally in the same manner as for the pulsewidth measurement procedure.
2. Turn the horizontal POSITION control in order to set the upper 10% point of the waveform on the vertical center line of the graticule.(in Figure 4-4-2-(1), the upper 10% point is 0.4 division below the top of the pulse since the displayed amplitude is 4 divisions.) Read the distance T 1 between the vertical center line and the point at which the rising (or falling) edge crosses the horizontal center line.
3. Shift and set the lower 10% point of the waveform to the vertical center line of the graticule as shown by the dotted line in figure 4-4-2-(1). Read the distance T2 between the vertical center line and the point at which the rising (or falling) edge crosses the horizontal center line.
4. Calculate the rise (or fall) time by substituting the sum of T 1 and T 2 for Equation 4-4.

Figure 4-4-2-(1). Rise (or fall) time meaurement (Without using the cursor)



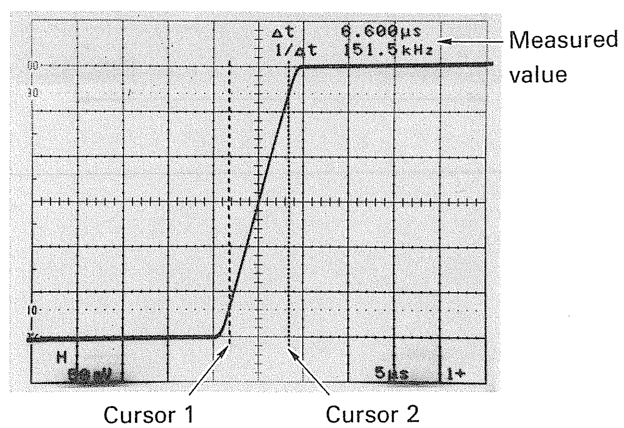
<Measurements using the cursor I>

1. Press the cursor measurement mode Δt·1/Δt switch.
2. Display the waveform in the same manner as step 3 above, set cursor 1 to 10% from the bottom of the waveform and cursor 2 to 10% from the top of the waveform and measure. (See Figure 4-4-2-(2).)

<Measurements using the cursor II>

1. Display the pulse rise (fall) magnified on the screen.
2. Press the Δt·1/Δt switch and ΔV switch. (See Figure 4-4-2-(3)a.)
3. Set to V mode by pulling the CURSORS 1 control and move cursors 1 and 2 to the bottom and top of the waveform respectively. (See Figure 4-4-2-(3)b.)
4. Press the %·dB switch.
5. Press the REF SET switch and then the %·dB switch. (V cursors 1 and 2 move automatically to 80%-1.9dB on the displayed waveform.) (See Figure 4-4-2-(3)c.)
6. Move the H cursors 1 and 2 to the points where the V cursors 1 and 2 intersect the waveform. Then the waveform rise and fall time are calculated and displayed digitally. (See Figure 4-4-2-(3)d.)

Figure 4-4-2-(2). Rise (or fall) time meaurement (Using the cursors I)

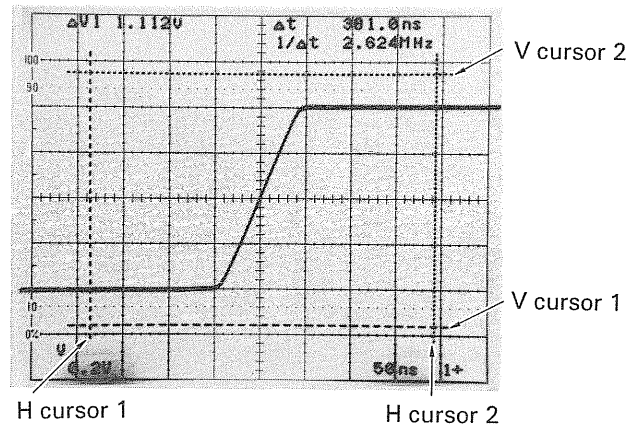


SS-6122
Section 4 Measuring Instructions

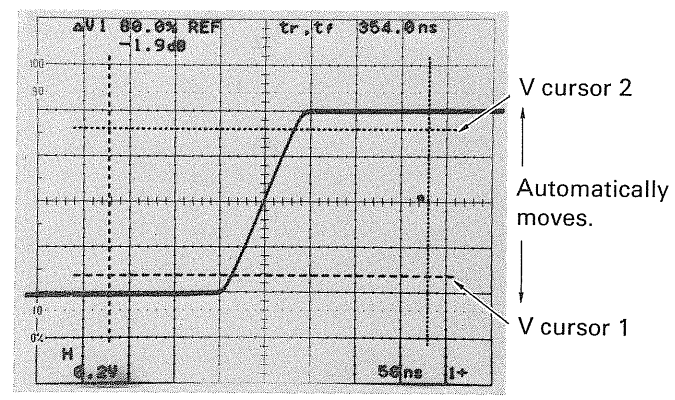
4-4-3 Observation of Rise (Fall) Portion of Waveform

Since the vertical deflection system of the SS-6122 has a signal delay circuit, the leading edge of a waveform can easily be observed on the screen.

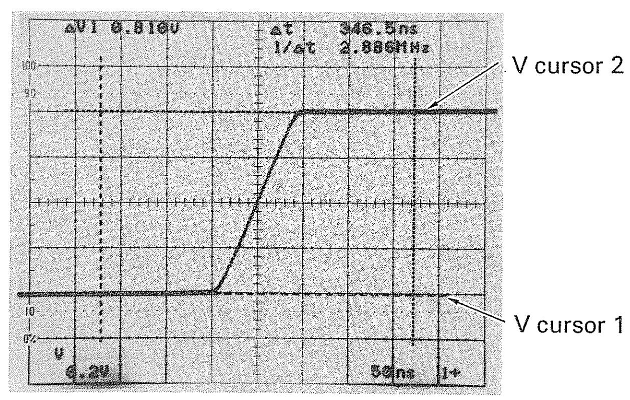
Figure 4-4-2-(3). Rise (or fall) time meaurement (Using the cursors II)



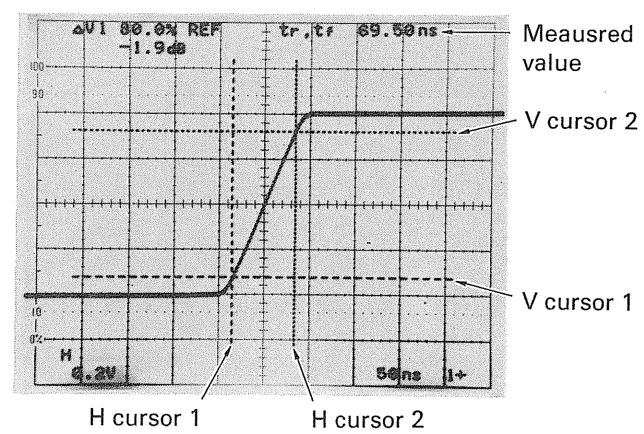
a. Press the Δt·1/Δt and ΔV switches then cursors appear.



c. Press the PHASE/%·dB switch and press the REF SET switch. Press the PHASE /%·dB switch again.



b. Set the V mode display and move V cursors 1 and 2 to the top and bottom of the waveform respectively.



d. Set the H mode display and move H cursors 1 and 2 to the respective points where V cursors 1 and 2 intersect the waveform.

4-5 FREQUENCY MEASUREMENT

Of the frequency measurement procedure, there are the following methods.

<Measurements without using the cursor>

The first method: Calculate the one-cycle time (interval) of the input signal by Equation 4-4 as shown in Figure 4-5-(1) and obtain the frequeny by Equation 4-5-(1).

$$\text{Frequency(Hz)} = \frac{1\text{(c)}}{\text{Period(s)}} \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad 4\text{-}5\text{-}(1)$$

The second method: Count the repetition number N per 10 divisions in the viewing area, and calculate the frequency by Equation 4-5-(2).

Frequency(Hz)

$$= \frac{\text{N(c)}}{\text{SEC/DIV setting value(s/div)} \times 10\text{(div)}} \cdots\cdots \quad 4\text{-}5\text{-}(2)$$

When N is large (30 to 50), the second method can give a higher accuracy level than that obtained with the first method. This accuracy is approximately equal to the rated accuracy of sweep rate. However, when N is small, the count below decimal point becomes very ambiguous, which results in considerable error.

For the measurement of comparatively low frequencies having a simple pattern such as sine wave, square wave, triangle wave, and sawtooth wave, measurement with high accuracy can be effected by the following method: Operate the oscilloscope as an X-Y scope, make the Lissajou's pattern by applying the signal of which frequency is known, and read the necessary value.

Figure 4-5-(1). Frequency measurement (Without using the cursor I)

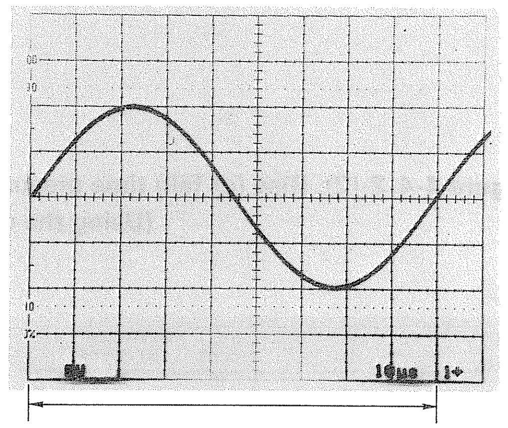
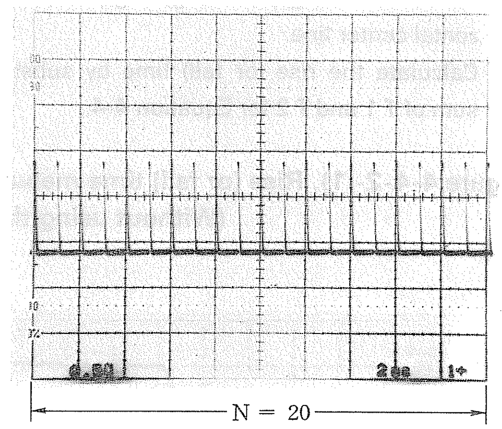


Figure 4-5-(2). Frequency measurement (Without using the cursor II)

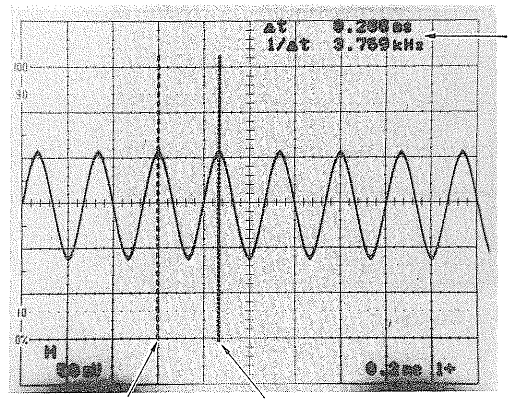


<Measurements using the cursor>

The fourth method uses the cursor.

1. Press the cursor measurement mode $\Delta t \cdot 1/\Delta t$ switch.
2. Move the H cursors 1 and 2 to the waveform to be measured. The frequency is displayed digitally. (See Figure 4-5-(3).)

Figure 4-5-(3). Frequency measurement (Using the cursors)

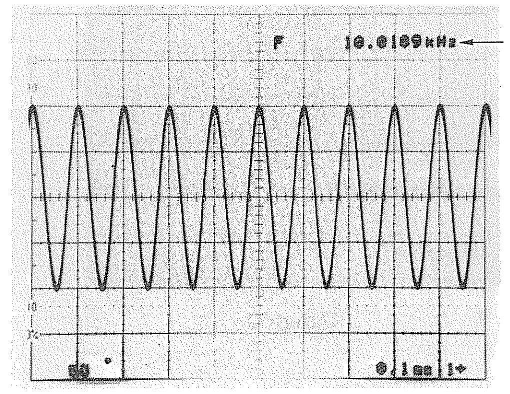


<Measurements using the digital counter>

The fifth method uses the internal counter.

1. Press the COUNT switch.
2. The A SOURCE with the same channel as the one to which the signal was applied is selected and the frequency or the period of the signal is measured and displayed digitally. (See frequency $1/\Delta t$ in section 3-13-2 and counter in section 3-13-9.)

Figure 4-5-(4). Measurements using digital (Using the digital counter)

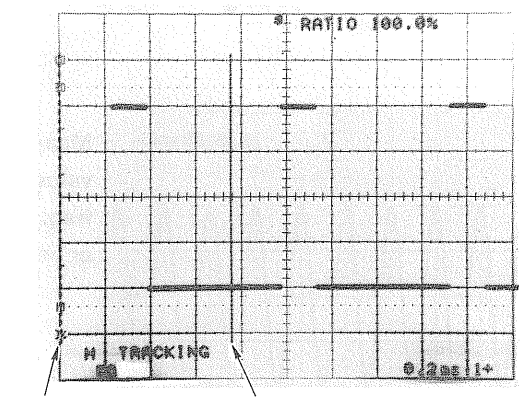


4-6 DUTY RATIO MEASUREMENT

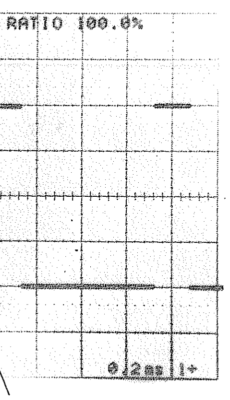
<Measurements using the cursor>

1. Press the Δt·1/Δt switch.
2. Press the RATIO/PEAK switch. Then the H cursor moves automatically to the left end of the screen aveform period in one interval. (See Figure 4-6 (a).)
3. Adjust the CURSORS 1 control to match the H cursors to one waveform period on the screen. (See Figure 4-6(b).)
4. Adjust the CURSORS 2 control to move cursor 2 to the fall of the first pulse. Then the pulse width ratio to the period in step 3 above is measured and displayed digitally. (See Figure 4-6 (c).)

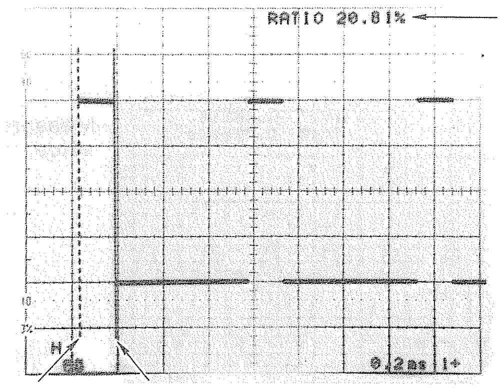
Figure 4-6. Duty ratio measurement methods



a. Press the RATIO/PEAK switch.



b. Adjust the H cursors to one waveform period.



c. Adjust the cursor 2 to the fall of the first pulse.

4-7 PHASE DIFFERENCE MEASUREMENT

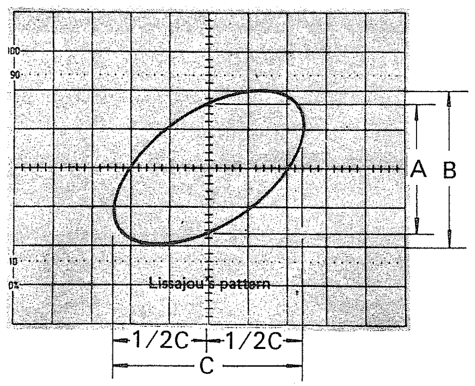
Of the measurement of phase difference between two signals, there are the following two methods:

<Measurements without using the cursor I>

The first one is the Lissajou's pattern method by using the instrument as an X-Y scope. The phase difference of signals can be calculated form the amplitudes A and B of the pattern shown if Figure 4-7-(1) and by Equation 4-7-(1).

Phase defference(deg)=$\sin-1\,\frac{A}{B}$.............. 4-7-(1)

Figure 4-7-(1). Phase different measurement by Lissajou's pattern (Without using the cursor I)



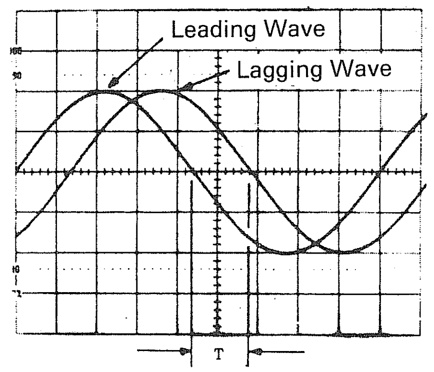
<Measurements without using the cursor II>

The second method is an application of dual-trace function Figure 4-7-(2) shows an example of dual-trace display of leading and lagging sine wave signals having the same frequency. In this case, the SOURCE switch must be set to a channel which is connected to the leading signal, and set the SEC/DIV switch so that the length of 1-cycle of the displayed sine wave may be 9 divisions.

Then, 1-division graticule represents a waveform phase of 40° (1 cycle=2π=360°). The phase difference between the two signals can be easily calculated by Equation 4-7-(2).

Phase difference(dig)=T(div)×40° .... 4-7-(2)

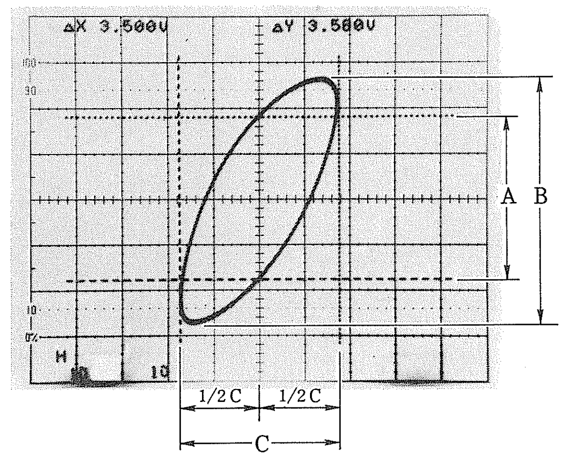
Figure 4-7-(2). Phase different measurement by dual trace display (Without using the cursor II)



<Measurements using the cursor I>

1. Press the Δt·1/Δt switch.
2. Adjust the V cursors to A in Figure 4-7-(3). Then the voltage is displayed as "ΔY."
3. Then adjust the H cursors to B. Then the voltage is displayed as "ΔY".
4. The phase difference is obtained from equation 4-7-(1) using the voltages in steps 2 and 3 above.

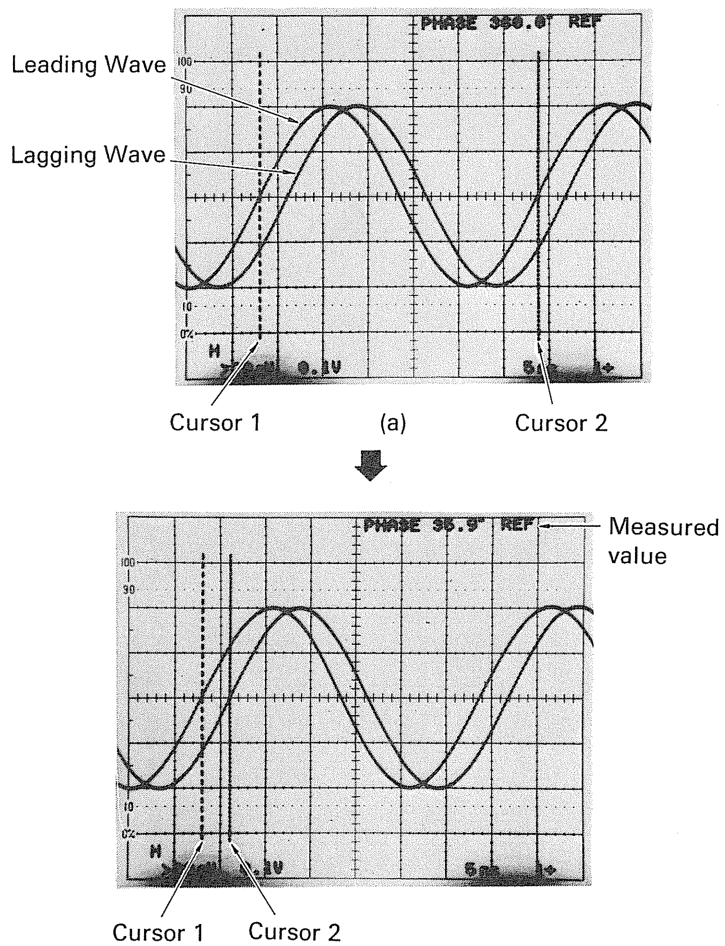
Figure 4-7-(3). Phase different measurement by Lissajou's pattern (Using the cursors I)



<Measurements using the cursor II>

1. Press the Δt·1/Δt switch.
2. Press the PHASE switch.
3. Match the H cursors to one period of the leading wave as shown in Figure 4-7-(4)a.
4. Press the REF SET switch.
5. Move cursor 2 to the lagging wave as shown in Figure 4-7-(4)b. Then the phase difference is calculated and displayed digitally.

Figure 4-7-(4). Phase different measurement by dual trace display (Using the cursors II)



4-8 FREQUENCY AND PERIOD MEASUREMENT REFERENCE

When the signals to be measured are higher than 10MHz, measurement reset opens by pressing the COUNT switch, the measurement gate for the duration of TIME BASE (0.1s) and counts the periods of the input signal dring this interval.

When the signals to be measured are lower than 10MHz, measure by the RECIPROCAL method.

4-8-1 RECIPROCAL Method

When the COUNT switch is pressed, the measurement reset opens the reference gate for the duration of the TIME BASE and then the measurement gate opens in triggering the input signals. When the reference gate closes, the measurement gate closes in triggering the input signal.

The interval "t" that the measurement gate is opened is counted with the reference clock (10MHz), the frequency "n" of the signal to be measured is counted during this time, and the frequency is obtianed by calculating f=n/t and displayed. (reciprocal calculation of the mean period)

When this method is used, the resolution of the result is determined by the measurement time regardless of the input frequency.

4-8-2 Measurement Error

Frequency measurement and period measurement are affected by "error based on the precision of the reference oscillator", "±1 counter erro", and "trigger error."

Error based on the precision of the reference oscillator: The count interval (gate interval) of frequency measurement and base time (internal base pulse period) of period measurement are created by dividing the frequency of the reference oscillator (crystal oscillator).

Therefore, the precisions of the above are determined by the precision of the reference oscillator.

±1 count error: Digital measuring instruments are high accuracy instruments. However, values counted by opening and closing gates are affected by the quantification error of the ±1 count error.

trigger error: In general, the measurement error due to trigger error is proportional to the noize level and increases as the slope of the trigger level of the input signal waveform decreases. In the case of sine wave shown in Figure 4-8-(1), the trigger error is at a minimum when the trigger level is set to the middle of the waveform. The relationship between the input signal voltage and noise voltage with the error can be expressed by the following equation.

$$\frac{2\Delta T}{T}=\frac{1}{\pi}\times\frac{En}{Es}=\left(\because \frac{En}{\Delta T}=\frac{2\pi Es}{T}\right)$$

From this equation, it can be seen that in the case of a sine wave, the error is determined by the ratio of the signal Es with the noise removed to the noise En and is unrelated to the frequency. For example, if the S/N ratio is 40dB, the error is 0.3% from the above equation and if the S/N ratio is 60dB it is 0.03%.

Also, the average for N periods of the input signalis

$$\frac{2\Delta T}{NT}=\frac{1}{\pi}\times\frac{En}{Es}\times\frac{1}{N}$$

and the error is decreaded to 1/Nth. Therefore, the effect of the noise can be decreased by obtaining the average for multiple periods.

How do these errors appear during measurement. Figure 4-8-(2) shows the relationship between the error and the input signal frequency (period) after calibrating for base pulse generator.

Figure 4-8-(1) Trigger error

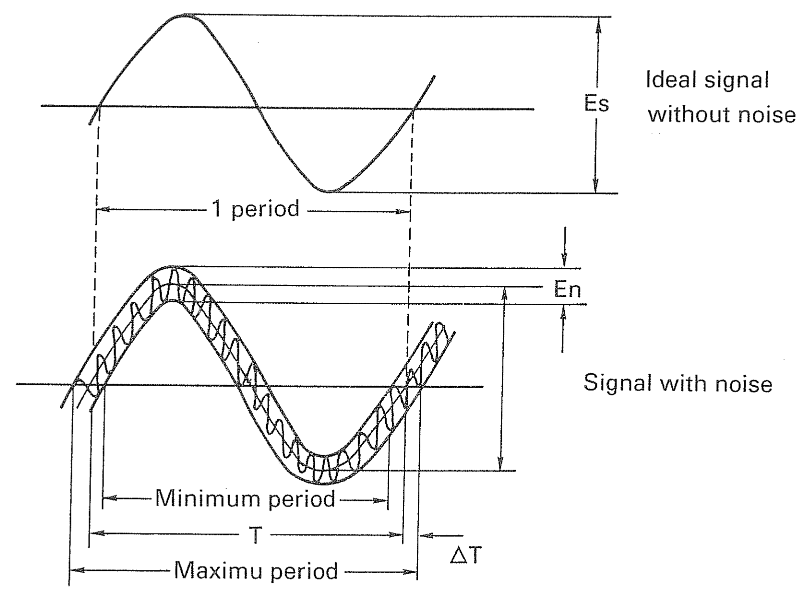
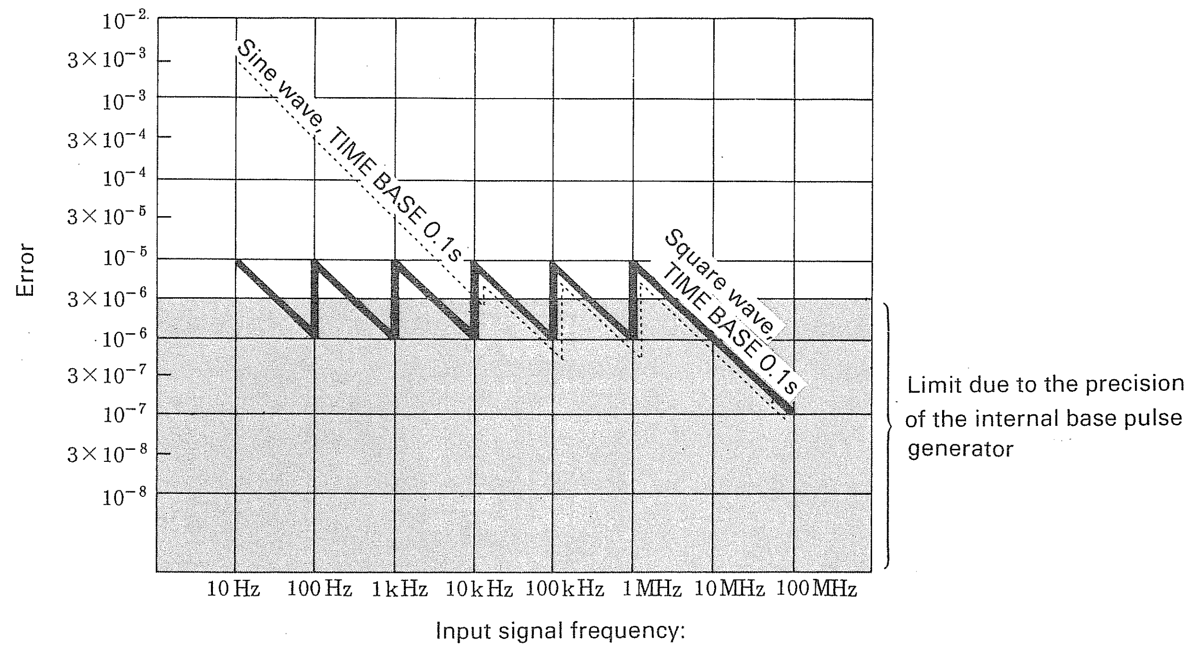


Figure 4-8-(2) Figure Frequency and error during frequency and perioed measurement (where S/N ratio is 40dB for sine wave)



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